

BSoD/Introduction to Materials

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Materials and Textures in Blender

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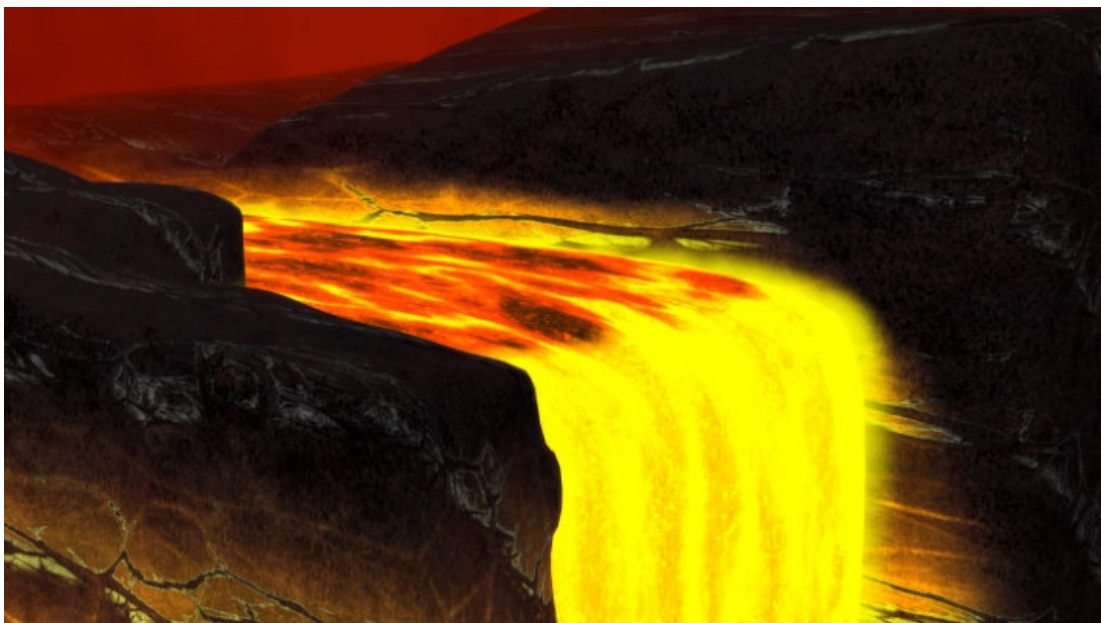
Introduction

Materials and textures are one of the most important tools in any 3D package. A superb mesh object will still look like a grey plastic toy without good textures. Yet materials and textures can be one of the most challenging aspects of the design process. Blender like many other comprehensive 3D suites has a vast array of tools that can help you create virtually any material either in reality or beyond. However, to the Blender beginner it can appear overwhelming. This documentation is designed to take you rapidly from no, or little knowledge, to the point where you can confidently create materials to your needs.



Morning, Caldera Waterfall, 2000m above sea level. You will discover how the materials were created for this scene, and others, as part of this training course

Blender material and texture settings will be covered by working through several real life exercises. Some of the exercises are challenging but they will introduce you to the underlying principles of material creation in a fun way.



Following a dramatic eruption overnight molten rock now flows down this lavafall. You will be able to transform the waterfall scene with the knowledge you learn with only a few material changes.

You will be shown a range of tools which if used creatively can produce scenes comparable to any feature film. I will show you how to approach the synthesis of a material in a logical way that you could apply to any 3D suite. Blender is the emphasis however, and it has some wonderful tools to make the process simple. Of course I cannot turn you into an artist but hopefully the pallet of tools presented to you will encourage your creative skills to produce magic in Blender.

Pre-requisites

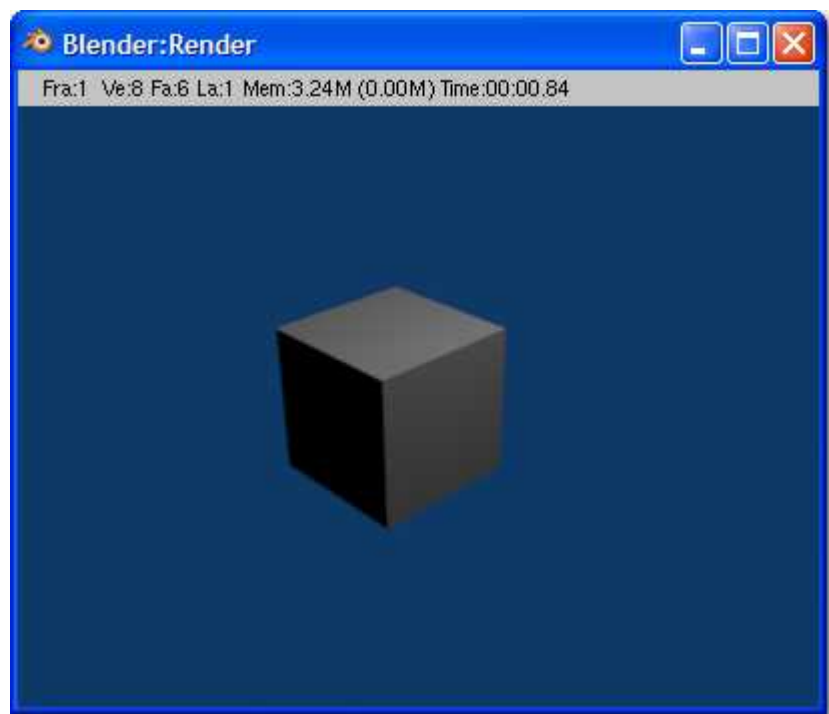
Absolutely none. You can approach this materials and textures section as a complete beginner. Hopefully you have already downloaded and installed Blender on your computer. I suspect that you will at least have pressed the F12 key to see a render of the default cube. Beyond that I will give instructions on exactly what to do.

Of course this is not a reference manual and will only cover materials and textures in detail. I will refer to reference sections elsewhere on the Blender Wiki and within the Blender Summer of Documentation. You are however encouraged to work through this boot camp training from beginning to end. Once you have done so it will make much more sense to go back to sections to remind or reinforce areas where you need more help and therefore aid you in your journey to create better materials in Blender.

Materials and Textures in Blender

What is a material?

Blender, like any 3D design suite, is essentially a **simulation** program. Points are placed in a pseudo 3D space (Vertices) and these points are joined to form faces. Faces are then lit with **simulated** lights and a **simulated** camera is placed looking at our pseudo object. All this has to be done before our **simulated** object and world can be rendered in all its glory.

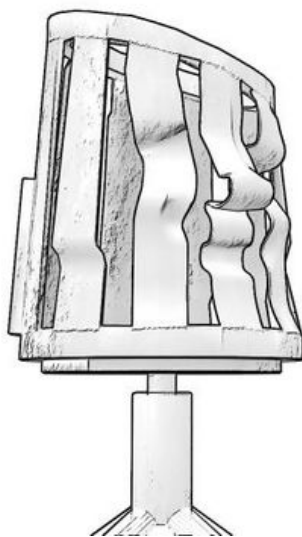


Exactly the same is true of Materials and Textures in any 3D system. They are the tools that help you simulate a surface color or property that will turn a boring grey plastic looking object into something much more interesting.



Photo realistic render from Blender

This could be based on a photorealistic interpretation of a real material or on some artistic style, like a cartoon, or an impressionistic painting.



Line illustration render from Blender to simulate a drawing

In other words Materials and Textures offer an enormous palette of color, style, and effect, that can be applied to the untextured 3d objects and turn them into a truly inspiring picture or animation.

Of course, this means that there is no magic button to press in Blender, or any 3D package, that will automatically produce realistic, or good looking materials. You have to make decisions about many settings and choices, as well as apply observational and artistic skills. All of these choices can appear daunting to the beginning 3D artist. Indeed many competent artists find it difficult to move from more traditional forms of art because of the apparent need to know every 3D tool before they can attempt a picture or animation. However, that's why we are here to help you. Over the coming sections you will have the chance to quickly simulate realistic looking materials as well as a strategy to apply to any material simulation. You will also see that you can start achieving with only a few tools at your disposal. Gradually building your knowledge and confidence as you progress. Fortunately you have chosen a very capable and easy to understand 3D suite with Blender. It made the task easier for me than many commercial packages that I had tried before.

The material UI

Hopefully you will be familiar with the Blender User Interface (UI). The default setup of the screen is where you will perform all the magic. Both in creating great mesh objects and also in designing inspired materials to bring those meshes to life. You are able to modify the default screen to suit the way you like working but Blender has some additional UI choices that can help with each aspect of the design process.



Screen Layouts

You can choose a range of screen setups to help :-

Model – with a layout to aid the creation of objects

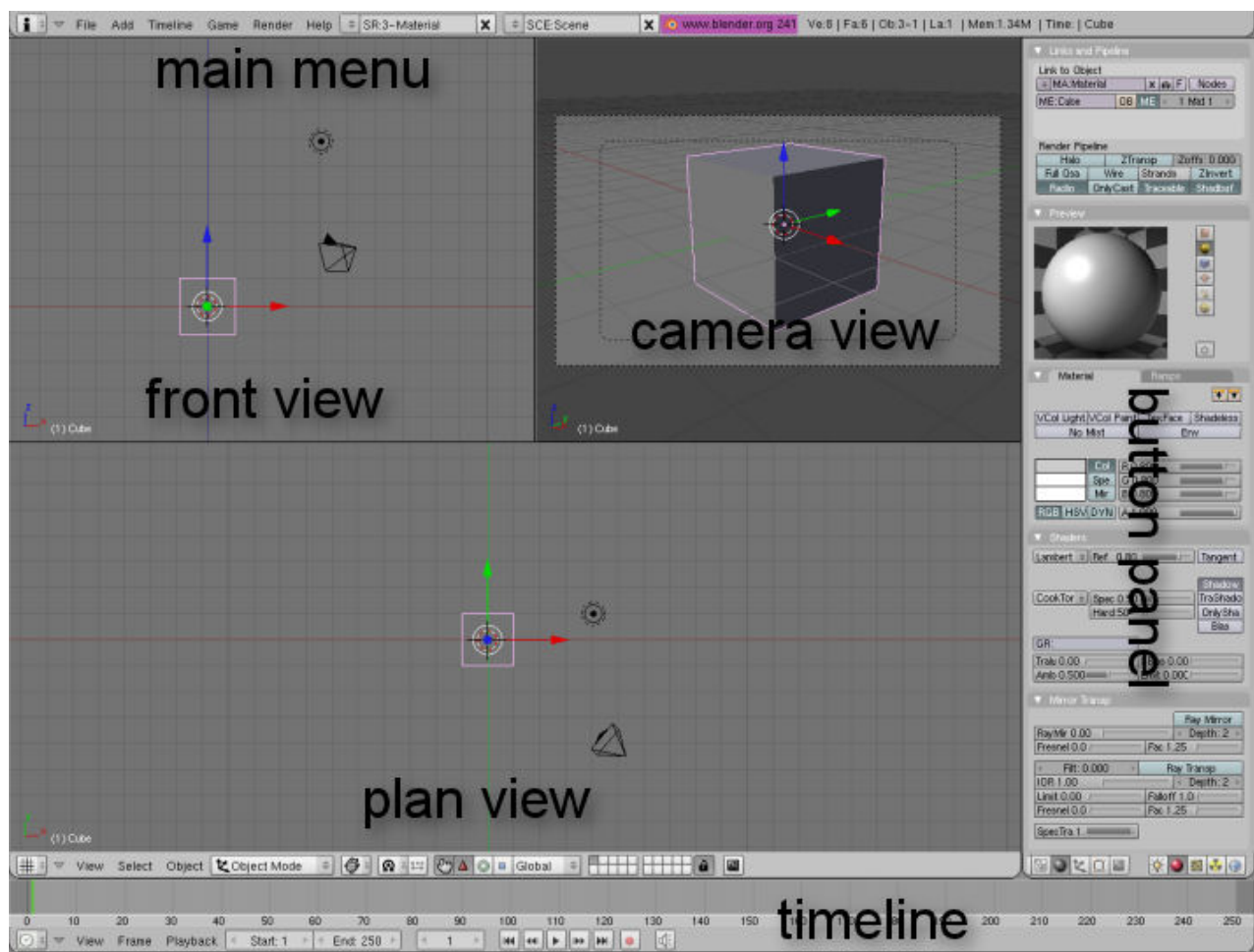
Animation – with a layout to aid the animation process

Sequencer – with a layout to help you edit your shots into a film. Did you realise that Blender has a very capable non-linear editor for both animations and sound?

Scripting – with a layout that will help the budding programmer produce python additions to Blender, and

Materials – you guessed it a layout to aid the creation of materials.

The Materials Layout



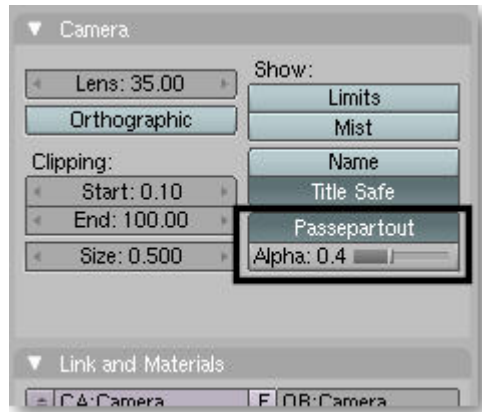
After a little practice with Blender you may wish to change the layout of any of these pre-built UI windows. As you will probably notice my camera view is a little different from the default. I have set a darker frame around the camera view to emphasis the framing of any shot. I find this very useful when I am setting a shot or working out whats in frame from a materials viewpoint.

Useful Modifications from the Default

This was done by selecting the camera.

Point with the mouse cursor at the camera frustum and **RMB** to select it.

Move the cursor to the buttons panel and press **F9** for the Editing buttons.

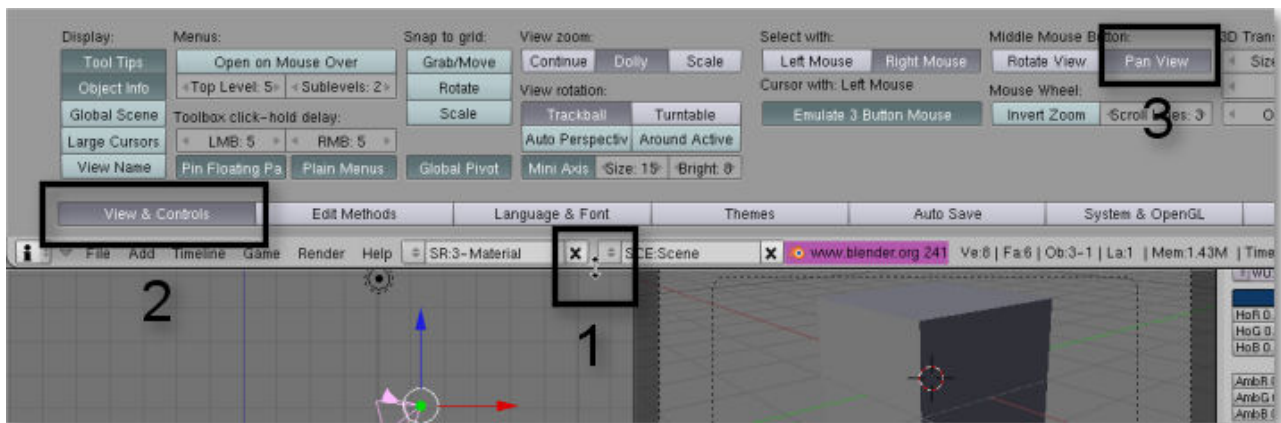


Apart from all the interesting settings for the camera, like the focal length, you will see a button called **passepartout**.

Select this and adjust the alpha slider below it to adjust the darkness and transparency of the frame around the camera view.

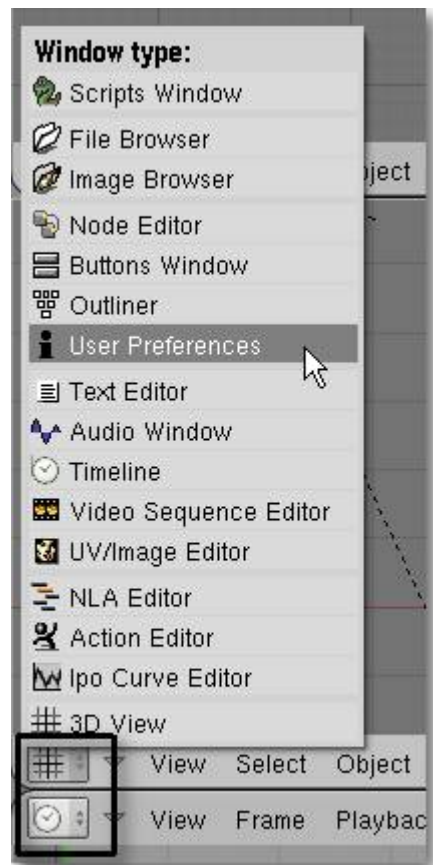
Panning a view rather than Rotating

I have also found that I prefer that the middle mouse button **Pans** the view rather than **Rotates** it when I press and hold the **MMB** and drag over any of the view windows. To change this from the default, which is **ROTATE** you have to:-



1. point your cursor at the bottom line of the main menu and drag it down to reveal the Blender options.
2. Select the View & Controls button, and
3. From the revealed options select **Pan View** from the **Middle Mouse Button:** option.

Remember to return the main menu to the top of the screen by dragging the bottom line of the main menu back up.



It is also possible to change any of the windows to the **User Preferences** view. To make these changes select the **Display Window type** selector in the **header** of the window and select **User Preferences** from the displayed list.

Once you have made the changes required you can return the window to its former use by **LMB** that type selector again and choosing the window type you require.

Any window can be changed to any of the window types available which makes the UI very flexible in use.

At this point you can save your slightly modified Blender UI by pressing **CTRL+U** which saves a new version of the default setup.

You can add entirely new UI setups and make them available from the screens setup selector. But that's beyond the scope of this tutorial. To learn more go here

<http://mediawiki.blender.org/index.php/Manual/PartI/Interface/Screens>

Of course you are not forced to make these suggested changes to be able to create materials and textures in Blender. But they both work for me. In fact over the coming pages I will offer other tips that may help you become more productive in your artistic efforts in Blender.

Approaches to simulating a real material

Time to get down to creating materials in Blender. As a starter exercise I wanted to show how a relatively complex surface material can be created with just a few commands in Blender. I also want to show an approach to simulating a real material that you can use time and time again to speed up the process. However, at the same time I don't want to bog you down with too many explanations of each function and what it is doing. So initially some commands and options will be glossed over to help you achieve as quickly as possible. Don't worry though we will come back to those areas in more detail later.

The best tools you can employ in creating any material are your eyes. Direct visual interpretation of what you are trying to simulate really is the best way to start material and texture creation. For that reason we will start with a surface that I can see quite clearly in front of me now.

My office desk



caption The real table top. Photographs often produce their own color cast so the eye is a better observer.

You cannot see my desk directly so I'm setting the colors etc as my eyes see them. Later you might want to change the colors to your interpretation of the photo. Just be aware that modern digital cameras can add color casts due to the mixing of real and artificial light in a room. The eye automatically compensates for these differences.

Exercise 1

We will start with the simple desk surface, ignoring for now the power adapter and leads.

Creating the object and setting the lights

Any surface, such as our desktop, either passes the light diffusely, or specularly reflected from it. That means we require some simulated lights to represent the lights that exist in the real scene. Hopefully you will have read the BSoD section on lighting by now.

http://mediawiki.blender.org/index.php/BSoD/Introduction_to_Lighting

If not don't worry because I include the blendfile, with lights setup to represent the window and reflected light in the room, so that you can start at the same point as me.

[Media: desktop-01.blend](#)

Download the desktop-01.blend and save it into your main blender directory.

Diffuse Light

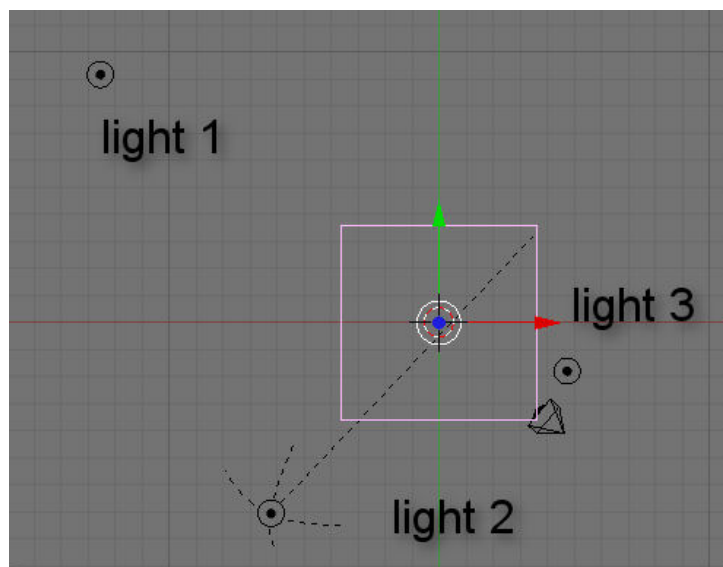
Any surface, such as our desktop, will reflect light bouncing off and back to our eyes. The general light is often called diffuse because it's more evenly scattered. Such light will illuminate the overall color of a surface.

Specular Light

Some surfaces will also have specular highlights where the light reflects in a more concentrated manner giving shininess to the surface.

It's therefore important that lights are setup to ensure our materials are seen correctly.

In our example there are 3 lights.



NOTE:

If anyone is reading this from my work please be assured that I only Blend during my lunch break. This can be verified by computing back the angle of the sunlight through the window to show that the time in July 2006 the picture could only have been taken between 12:30 and 13:30. **Honest.**

Light 1 represents the outside sunlight that is coming through the window.

Lights 2 & 3 are there to represent light bouncing off of the walls and the artificial light source in the room.

It is possible to setup very realistic lighting setups that will accurately mimic the scientific properties of real lights but I prefer to use quite simple setups that copy the general location and brightness of real world lights. Simple setups mean that you can easily arrange and fine tune their effect and therefore concentrate on making a material perfect.

If you want to learn more on lighting then read the BSoD section on lighting
http://mediawiki.blender.org/index.php/BSoD/Introduction_to_Lighting.

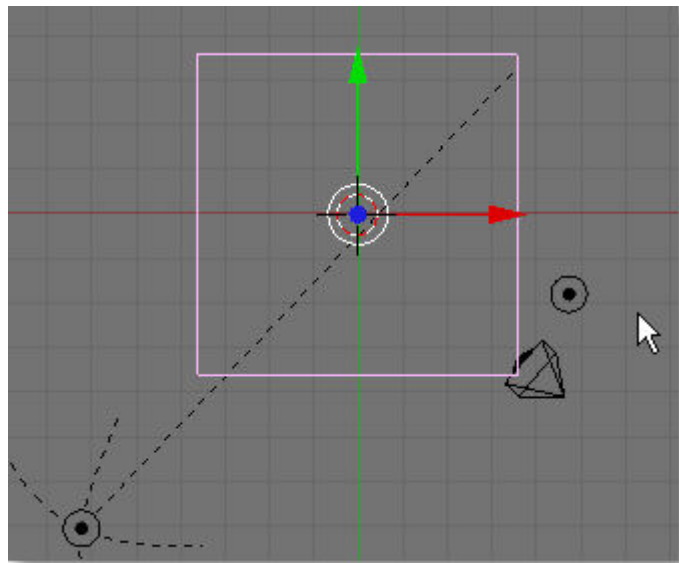
An approach to Materials (Shading)

Since a surface is lit by lights that will give diffuse and specular lighting it is not surprising that 3D applications often refer to these types of property in their material settings. Blender is no exception so let's setup the diffuse properties for our desk surface.

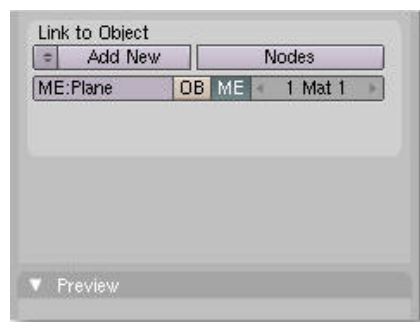
Adding a New Material

Before we can do so it is necessary to create a new material for the plane surface. So ensure that the plane is selected:

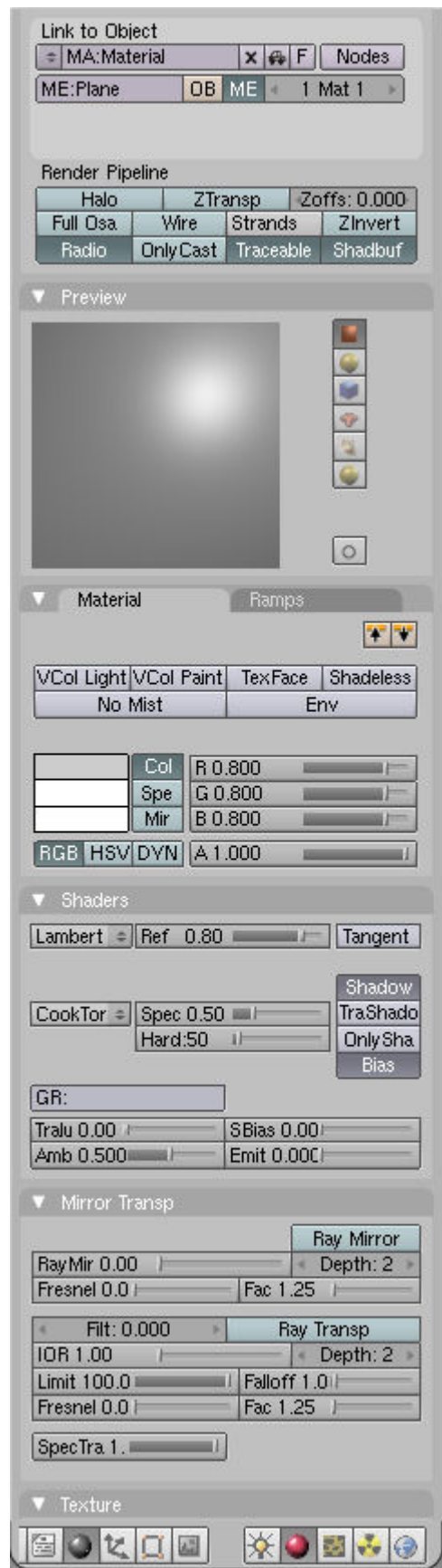
RMB will select the object under the pointer. You will know it is selected because a pink outline will highlight the object.



The button Panel should already be displaying the materials button as shown to the right.



Under the Links and **Pipeline tab** in the **Material** button is the **Add New** button. Select this so that a new material will be created for our desktop object.

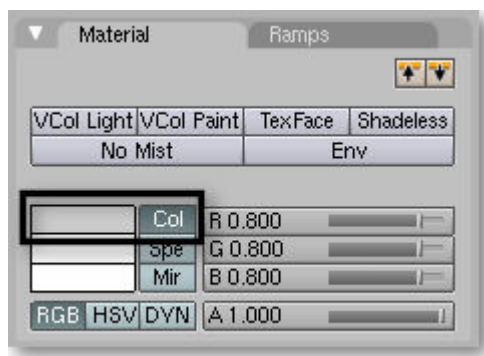


As you can see Blender creates a default grey material for our object. It's from this default that we will make modifications to turn the material into more of a wooden desktop like surface. Don't worry about all those settings displayed. At this stage only a few of them are necessary to produce our wood desktop.

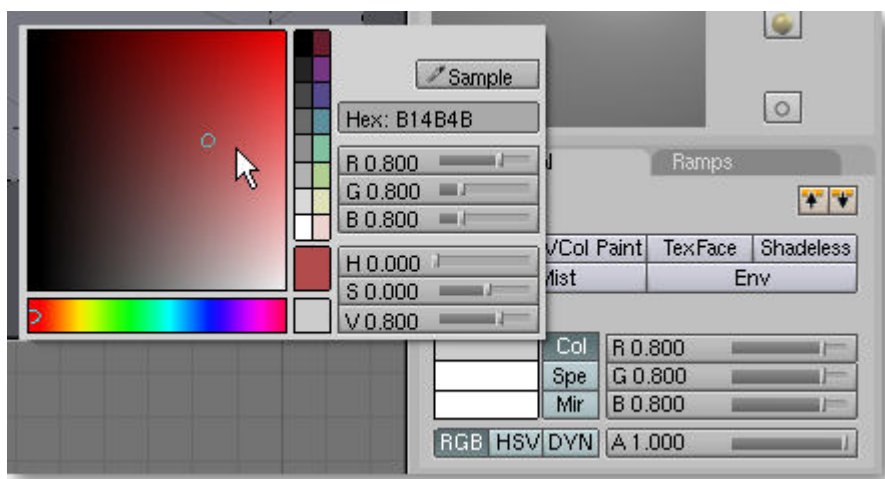
Diffuse shading (Material general color)

One of the easiest things to do is to setup the general color of the material.

Just below the preview tab you should see a **Material** tab with settings for the color.



- **LMB** click the swatch of the **COL** button to bring up a **color picker**.

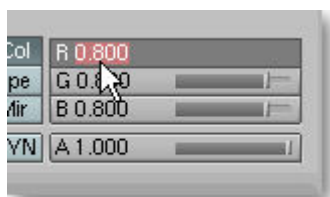


Here you can drag across the color panels to select any color you like. Try it.

LMB a color then confirm it by pressing the **ENTER KEY**.

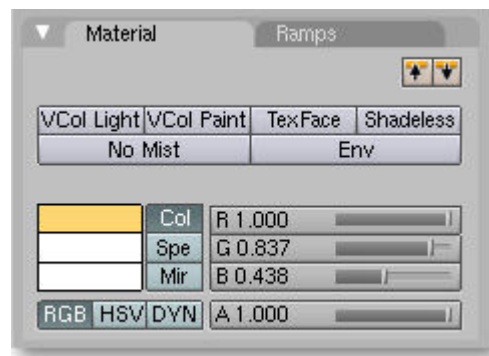
The material will now have a diffuse color based on your choice. You are also able to manipulate the **R G B** sliders directly in the **material** tab or to enter values to accurately obtain the color you require.

That is what I want you to do now. **LMB** on the **R** value so that it changes color for direct numerical input.



- Enter **1.0** for **R(ed)** and press **TAB** to move down to the **G(reen)** entry.

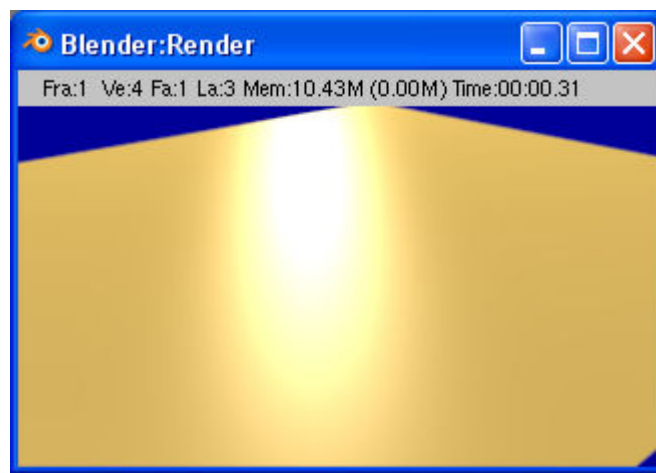
- Enter **0.837** and press TAB to move down to **B(lue)** entry.
- Enter **0.438**.



NOTE: Numeric entry and using the **TAB KEY** to move between entry points is a useful technique to learn in Blender. There are many other dialogs that can use this method.

I chose that color after very careful observation of the desk in front of me. If we were to render now this is what we would see.

- **F12** to render



SAVE YOUR WORK REGULARLY

When you are working on any creative process involving computers it's a good idea to regularly save your work. It's also a good policy to make incremental saves of your work so that if you want to return to a previous save you can do so. Fortunately Blender has a great incremental save feature.

From the File menu select Save As

On the Numeric Keypad press **+**

The filename will be appended by a number or incremented if it already has one at the end of its filename. Since the initial blend file you downloaded was called **desktop-01.blend** it will be updated to **desktop-02.blend**.

Press **ENTER** to confirm the save.

Do this regularly to save yourself heartache.

Specular Shading (Shininess of a material)

Any surface will have a certain level of shininess. This could be as a result of its own properties like glass, or as a result of reacting with something. A dry rock surface as opposed to a wet one. This is often referred to as specular shading.

Blender implements both diffuse and specular shader models under the **Shading** tab of the models button.



The **Lambert** model is one of several available for **Diffuse shading** and the **CookTorr** is one of a series of **Specular** models. Later you will learn about the others but for now we are going to stick with the defaults. In fact the default specular model settings of **Spec 0.50** and **Hard of 50** are fine for our desk surface.

Variation across the material surface

I can't think of any surface that has a totally uniform color, shininess, or flatness. In fact variation across a material surface is the single most important thing that will transform a dull and obvious 3D generated looking material into an authentic, or at least, a more interesting surface representation.

In order to add any variation to these properties it's necessary to add textures to our material.

Textures

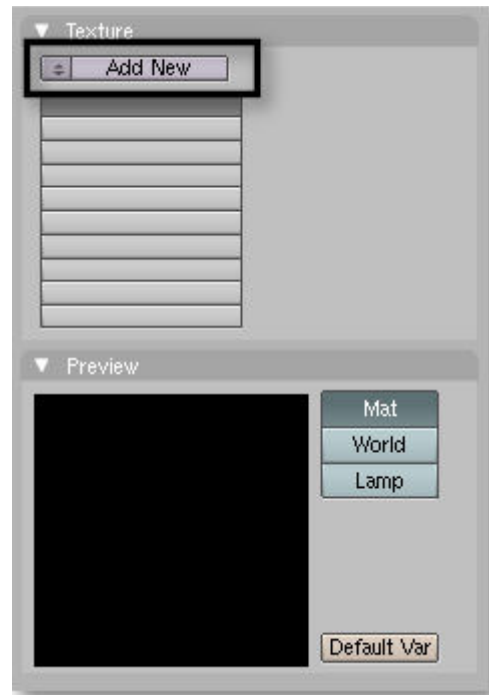
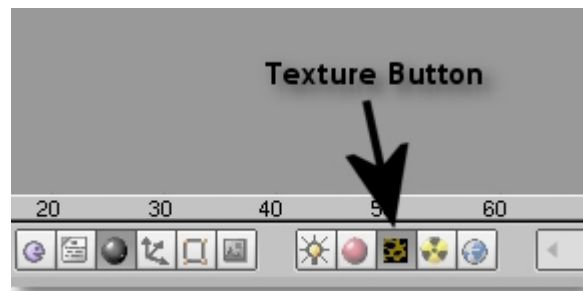
Blender offers the ability to apply up to 10 texture layers within a standard Blender material. It is possible by using material nodes to have an almost limitless number of textures applied to a Node material. That is however, beyond the scope of this training section. It is important to realize that in order to use nodes you should at least master the techniques of standard Blender materials and texture creation which is the purpose of this BSoD bootcamp training text.

Observation of the desk surface revealed that apart from the wood grain there were some subtle and random variations in color across the surface. We therefore need a similar random texture to give us color variation to our shading model.

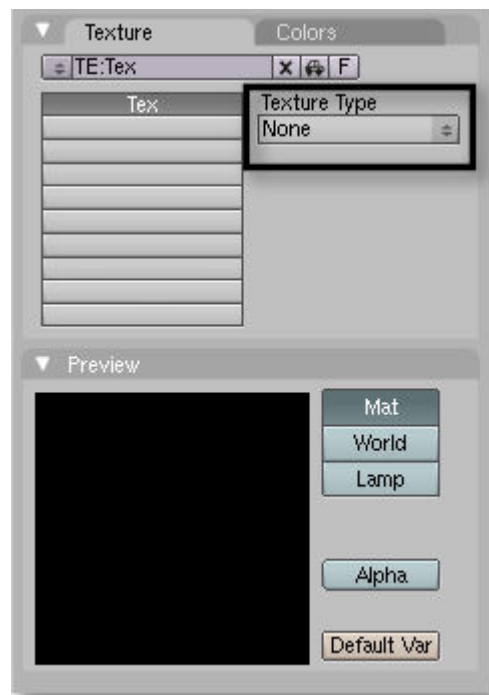
Textures in blender

Textures in Blender offer a huge range of possibilities to help modify your material. For this reason it can appear a little daunting. However, I will be covering the details of textures in later sections so for now just follow along the settings suggested.

- Switch the buttons view window to Textures **F6** or **LMB**  the textures icon.

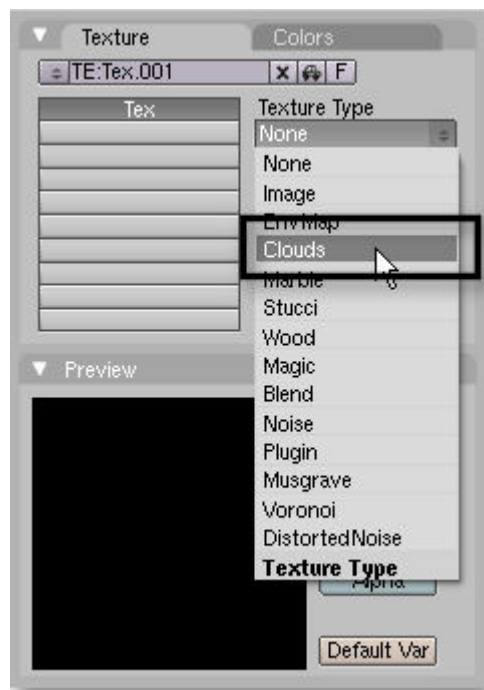


LMB on the **Add New** button.

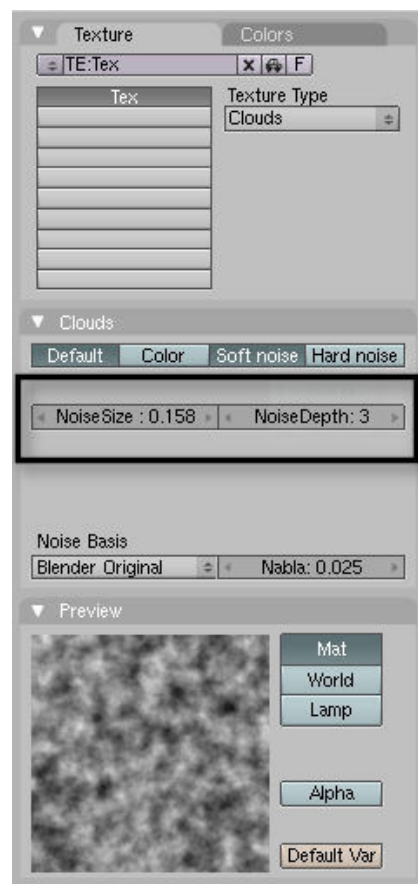



A new texture is created in the first slot with a default name. Currently there is no texture type assigned so the preview is blank.

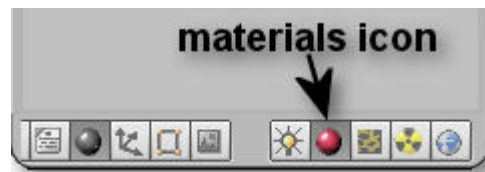
- Click the **Texture Type** button, where it says **None**, to display a list of available textures and from the list select **Clouds**.



The **Preview** tab gives an indication of what the texture looks like. This, as its name suggests, is like cloud.



- Change the **Noise Size** to **0.158** and the **Noise Depth** to **3**.
- Switch back to **Materials Button** F5 or **LMB**  the materials icon.



As soon as a material has a texture attached a lot of new options appear. We will be dealing with most of these latter but for now we only need to worry about 3 things:-

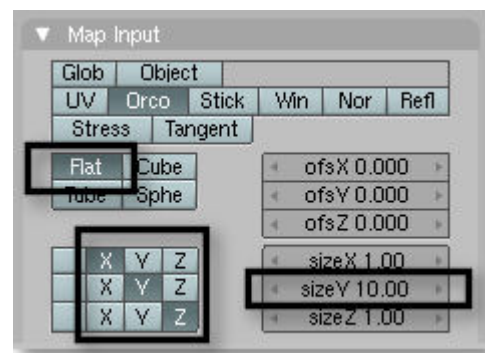
- How will the texture be mapped or projected on the surface.
- What will be the size and orientation of that projection
- And how will the texture interact with the underlying material.

Mapping

Fortunately the default mapping is called **FLAT** and because we have a nice flat surface to apply the texture to that's the best option anyway. Later I will introduce all of the mapping methods and there uses.

http://mediawiki.blender.org/index.php/BSoD/Introduction_to_Materials/part1j

The tab that has these settings is called **Map Input**.

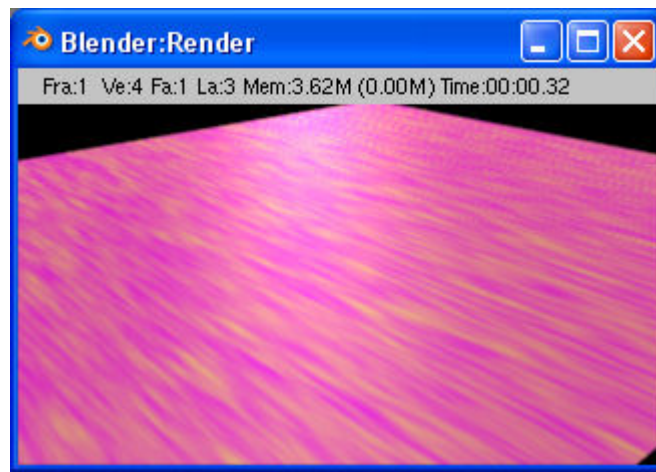


Ensure that **Flat** and **X Y Z** are set. These are the defaults for any texture so you shouldn't have to change them.

Size and orientation

Although we have already set a **Noise Size** in the texture button we are able to have greater control over the textures size and orientation in the **Map Input tab**. Alter the **sizeY** to **10.00**. This will squash the **Y** axis mapping of the texture which makes it look more like a variation caused by the direction of the wood grain.

If you were to render now material would look very strange.

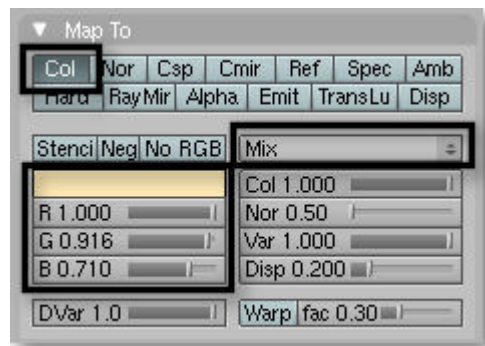


Currently Blender doesn't know what you want the texture to do so it's applying it as a default Cyan color.

NOTE: You may ask why this interesting color is used as a default. Well I believe it was chosen as a good contrast color so that you can easily see the pattern a texture might make on your material. Either that or someone has a serious color obsession!

Texture Interaction with the Material (Map To)

The **Map To** tab in the **Materials** button also has a whole host of options that we will cover later. But for now it's a color variation that I'm interested in so the **Col** option and the particular color I want to **Mix** that are the important things.



If you render this time you will see that the desk material looks much better **F12**.

Bump

It's very common for any surface to have bumps, either as the result of damage or by the natural makeup of the surface. Adding these details can help fool the eye into believing the render is real. Such details don't have to be exact photographic duplicates of what you can see or what's in the photograph. For instance the wood grain on the desktop would be very difficult to copy exactly. However, it should be possible to come up with similar pattern and color so that it looks like the simulated desk was produced from the same materials as the original. So lets have a go at creating the wood grain.

The wood surface grain

If you look closely at the grain within wood you will see that it has both depth and color. In other words they form dents in the surface of the wood. If a covering of varnish or stain has been added

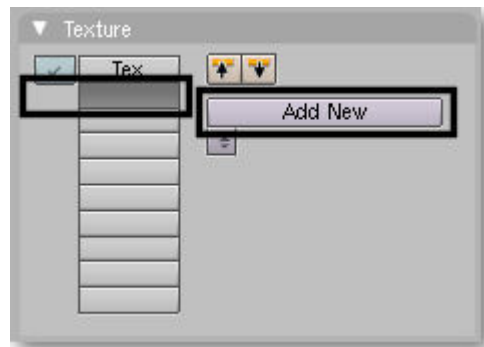
then quite often the grains fill slightly with the covering and darken. That's exactly what has happened with the desktop in front of me. In fact the grain is quite pronounced and much darker than the wood surface. Fortunately we can use textures to simulate the wood grain.

Textures are our friends (wood)

Since we have 10 Texture slots available within any single material we have plenty of space to add a wood grain to our material.

It's possible to add a new texture from within the materials button.

- Select the **Texture** tab from within the **Materials** button.

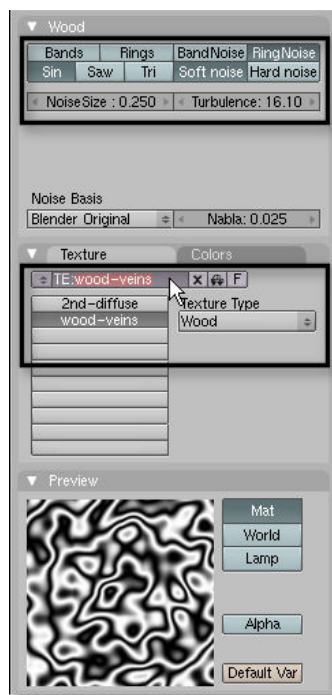


- **LMB** on the empty texture slot below the one we have already created.
- **LMB** on the *Add New* button to create a new texture in that slot.

You will notice that the name of the texture appears to be identical to the last one called Tex. However, the actual texture name is **Tex.001**. You could change it here by **LMB** on the name and entering one of your choice. It's easier to do that however, in the Texture button.

- Press **F6** (Texture Button)

The **Texture** button also has a **Texture** tab where you can **Add New** textures.



You can change the name of any texture that's selected by clicking the name and entering one of your choice. Here I have changed the name of both textures as a reminder of their function.

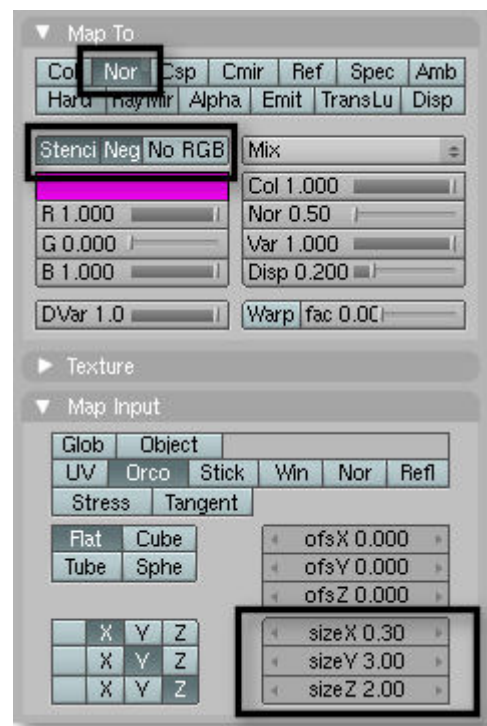
If you can't think of a name or you are completely lazy you can use the little motorcar icon. This will generate an automatic name based on the type of texture. Be warned however, that if you try to automatically name a blank texture its name will be None.

NOTE: It's always a good idea to meaningfully name things in Blender and Materials and Textures are no exception. You can easily lose track of what you are doing without the discipline of a good naming convention. Names are restricted to 19 characters which should be more than enough to help you out.

Back to our wood surface. Examination shows me that the grain is made from 2 elements. There are some broad elongated concentric rings that are slightly darker. Within those there are some thin and dark wood grain that has a pronounced indentation in the wood. We will start with the broader concentric rings.

I have chosen **wood** texture and **RingNoise** with a **Noise Size** of **0.250** and a **Turbulence** of **16.10**.

Go back to Materials button F5 so that we can decide how it will be mapped to the material.



More Mapping

This texture is only being mapped to the **Nor** value.

This refers to the normal of a surface which when applied with different textures will produce simulated bumps in the material. They are not real bumps so they won't alter mesh edges but they will give a very realistic interpretation of bumps & indentations on a surface. They will react with light shining on them and will appear as though they are self shadowing. Therefore deeper bumps will appear in shadow.

Stencil

Stencil will act as a mask on all texture slots that follow it. The **Neg** switch will reverse the stencil. These are great for restricting where a following texture will appear on our material. The reason it is being used here is because I want some small tight grain to only show through on some parts of the material. Thus leaving some of the original surface showing through.

Size

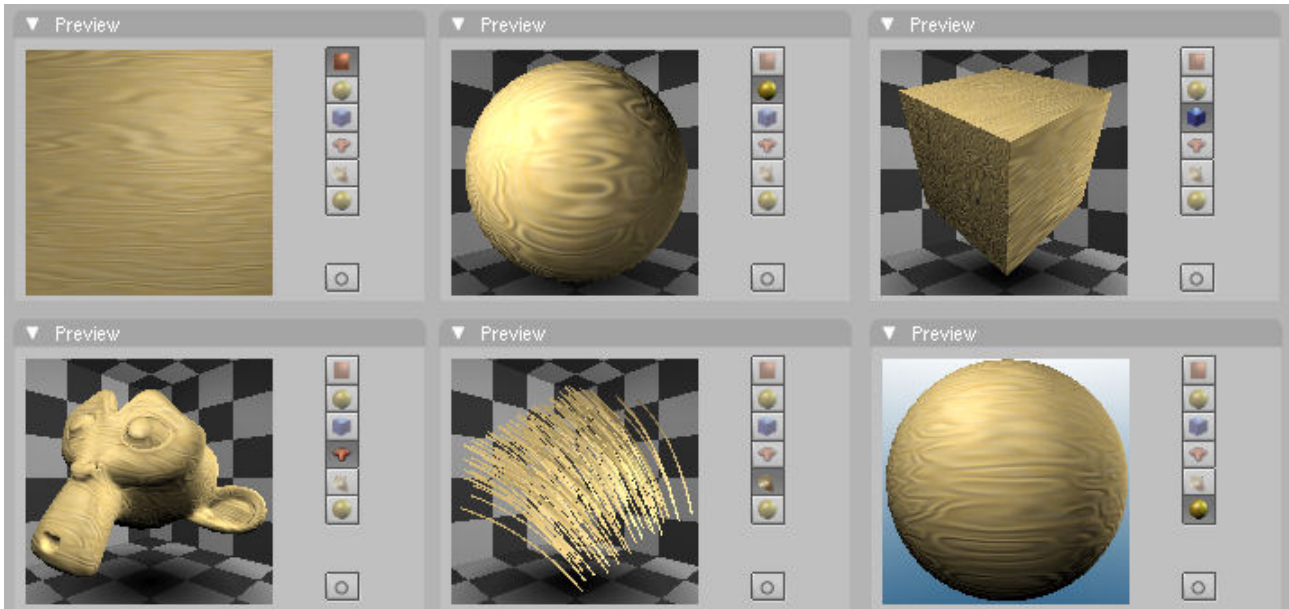
You will also see that I have changed the size of the texture to:-

sizeX = 0.30
sizeY = 3.00
sizeZ = 2.00

Those sizes were found after a few tests reaching a point I was happy with.

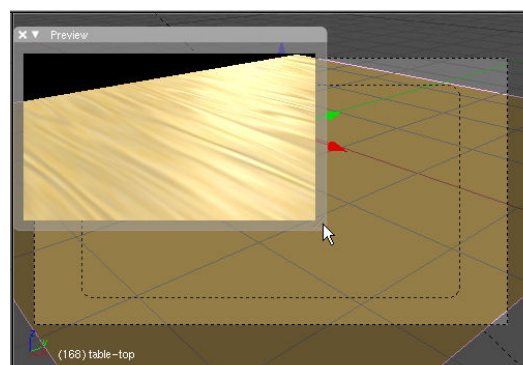
Previewing

It's possible to preview a material without resorting to a full render. The material button now has a very capable preview tab that derives its picture using the same render engine.



Although small you get an impression of how the material might look when applied to a variety of surfaces.

There is also a very neat preview screen that you can now setup in any window by pressing **SHIFT+P**.

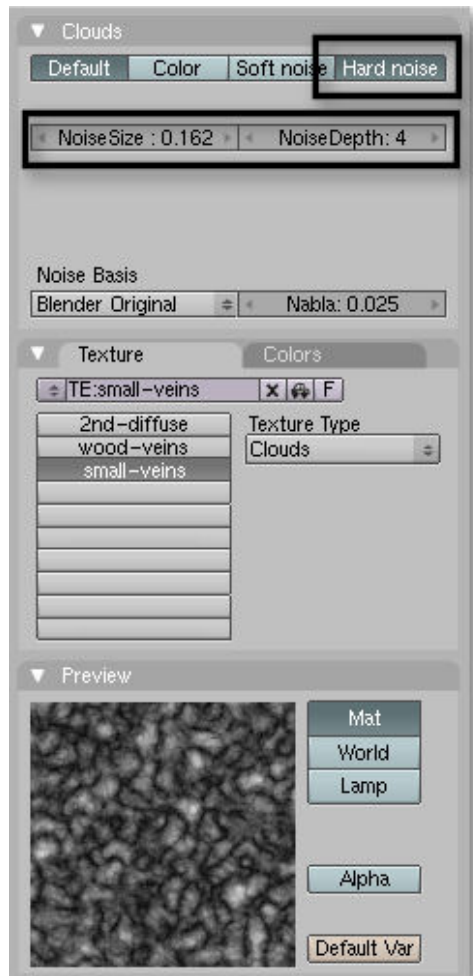


You can resize the preview by dragging the bottom right corner of the frame. Again the render uses the same engine and therefore is a good method of previewing as you are working on materials.

Multiple effects from a single texture

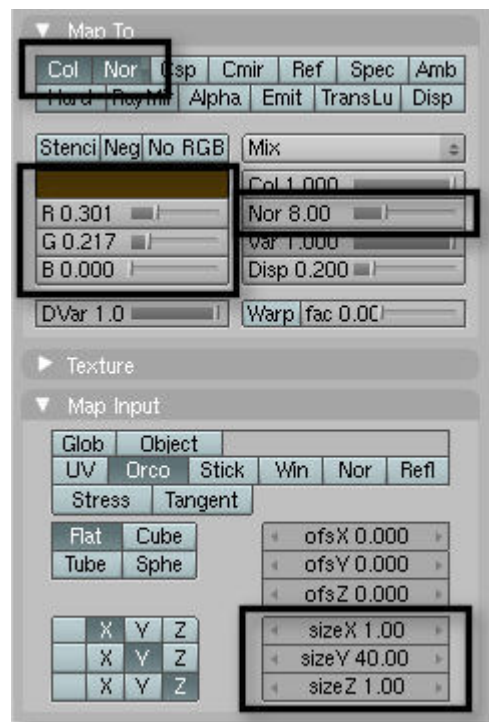
So far we have used single effects for each texture. It's possible to apply more than one effect from a single texture and we are going to do that with our next texture that will represent the thin wood veins that I can see on my real desktop.

- With the desktop object selected switch to the **Texture** Button **F6**.
- Add a new texture with the following settings.



This is another cloud texture with settings of **Hard noise** and **NoiseSize** set to **0.162** and **NoiseDepth** set at **4**.

Mapping

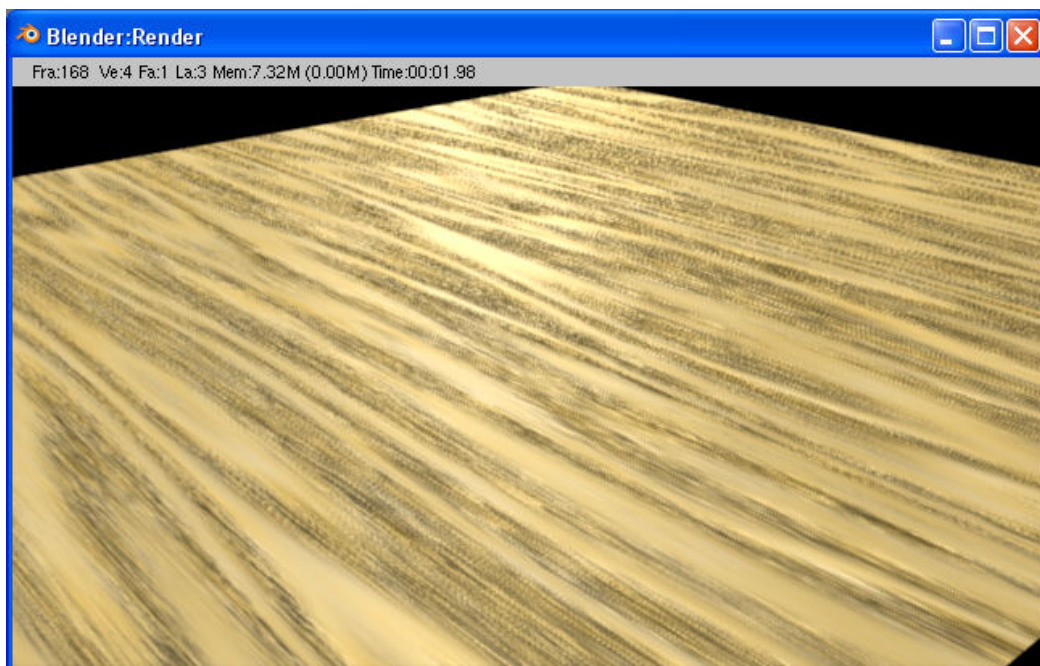


Under the **Map To** tab both **Col** and **Nor** are set. As we are also applying a color a dark brown has been set with:-

- **R(ed) = 0.301**
- **G(reen) = 0.217**
- **B(lue) = 0.000**

You will also notice that the **Nor** value is set to **8.00**. This is quite a high **Nor** value, although not the maximum. However, the texture effect that I am after, has very pronounced sharp edges in reality. Therefore I am trying to duplicate that look in the material.

A test render at this point is a good idea **F12**.

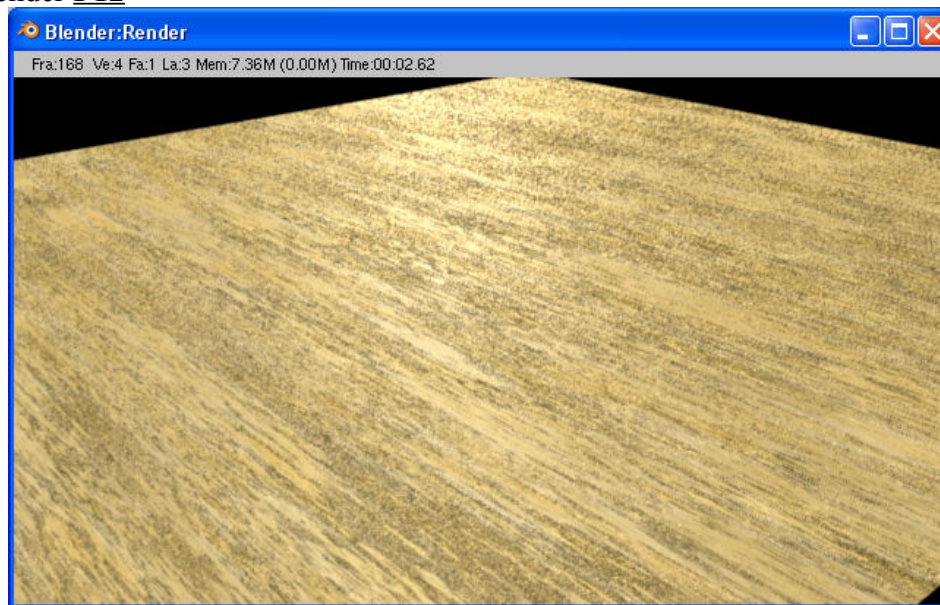


Not bad but the original desktop surface is more random. In fact there is probably a simple explanation and therefore solution to how that randomness occurs.

You will remember that the initial texture that we applied to the material was there to add the color variation that I could see on the surface. When a tree develops different seasons and weather vary the growth considerably. This can lead to denser areas within the wood that can also lead to colour variation. Since I know that the cloud texture applied as a color worked fine and looked authentic why don't I use that texture to warp the 2 grain textures just as it might have done in reality. Fortunately Textures also have a Warp feature for textures in slots above them so let's go back to that texture and set a warp value so that it will warp the wood grain for us.



- From the **Material** button select the top texture slot. The one I have named 2nd-diffuse.
- In the **Map To** tab **LMB** the **Warp** button to turn it on.
- Set the amount of warp to **0.30**. Although this may appear small the range is only 0 to 1 so small sizes are usually best for warp.
- Re-render **F12**



Interestingly although it's not the right material simulation yet it looks quite good. I would recommend that you render a HD image at 100%. Unfortunately I am unable to offer one here but it will give you enough time to take a break and stretch your legs.

...

Welcome back.

...

NOTE: The reason I asked you to do a full size HD image was so that you can see the full detail in the material. Reduced renders of fine lines, such as the small-veins in the image, can sometimes create moiré patterns. Even if you are going to create an image for a smaller size, if you render to a larger size and reduce the image with a paint package, you can reduce the effect of such patterns.

Any reflection from the material

Shiny surfaces will reflect light to give us specular highlights. But real shiny materials also reflect the world around them. A mirror for instance will reflect most of the world around them. Polished or glazed surfaces will also reflect the world to some extent.

Blender like many powerful 3D applications has an excellent RAYTRACE render engine. It works by tracing a ray from the camera back to a light source calculating any reflection, refraction, or absorption. This type of rendering gives the most realistic simulation of a scene. However, because it has to trace back to every light source the render calculations take much longer than does a render without raytracing.

In the early days of 3D design, before raytrace renders, the only way of simulating reflection was by using complex image maps or by careful use of lighting to represent reflected light from surfaces. Blender itself has an old method of mimicking reflection called **Env**(ronment) mapping.



Opening Title scene of Elephants Dream uses Env Mirror effect

However, Blenders Raytrace renderer is now very efficient and fast. As a result it is much easier to achieve a reflection using Raytrace and that's the method I shall explain here. If you want to learn about Env mapping go here:-

http://mediawiki.blender.org/index.php/Manual/PartIV/Environment_Maps

Setting Raytrace in the material

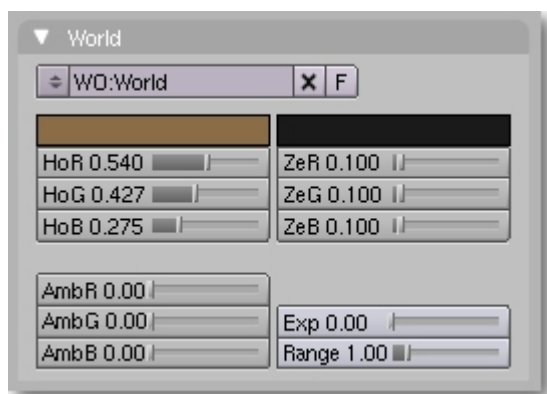
In order to use Raytracing you have to set the renderer to use that engine, as well as enable any materials to use a **Ray Mirror** effect. The default for Blender is that the render is set to Raytrace so I suspect you have been rendering with it already. However, none of the materials we have used so far have raytrace reflection enabled so you probably haven't seen the true raytraced effect.

NOTE: If you have no intension of using raytrace reflection or shadows in an image there is no point in having it set in the render. Indeed renders will unnecessarily take up to 12 x longer to render. So if you don't need raytraced reflections turn it off in the renderer.

Reflections need something to reflect

Currently our scene has nothing to reflect as only the desktop has been modelled. However, we don't need to model an entire office around our desktop. We can simulate the reflected color from the office walls by changing the world color to match what's in my office.

- Select the World button **F8** and change the color.



This type of wall, the standard magnolia loved by architects and the office decorators, absorb a fair amount of light before reflecting it on. So I have set the color a lot darker than the actual color to obtain the correct reflection.

Set the **HoR** to **0.540**, **HoG** to **0.427**, and **HoB** to **0.275**

Press **ENTER** to confirm those settings.

NOTE: The default Blender world color is a dark blue for some reason. Obviously chosen by the same person who opted for the Cyan texture color. I'm making the call to arrange counselling at the moment :)

Adding the Power Supply for some close-up reflection

Apart from the walls and the world around my desktop I have a power supply sat on the desk as well.

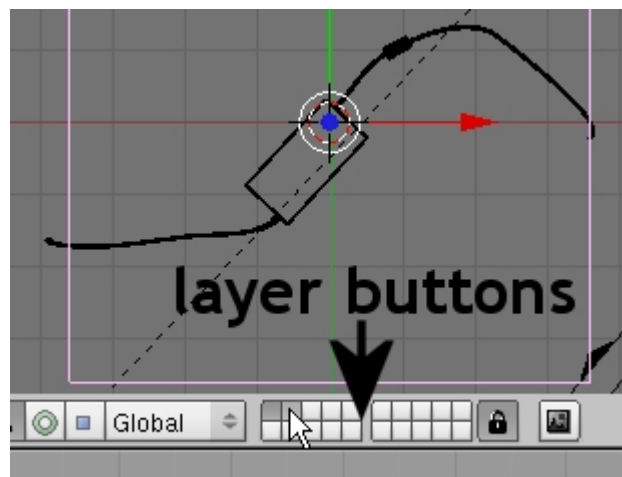


If you look closely what appears to be shadow below the supply and its cable is in fact a reflection on the desk surface and not really a shadow. My office is evenly illuminated and therefore you don't get many sharp shadows.

I have already created a simple mock-up of the power supply that you can quickly bring to this scene.

Layers in Blender

It's been hiding in another layer ready to be revealed to you.



There are 20 layers available and you can place objects and lights in these and only those layers selected will render. The power supply that I have provided is on layer 2 so to select it, and keep layer 1 active as well:-

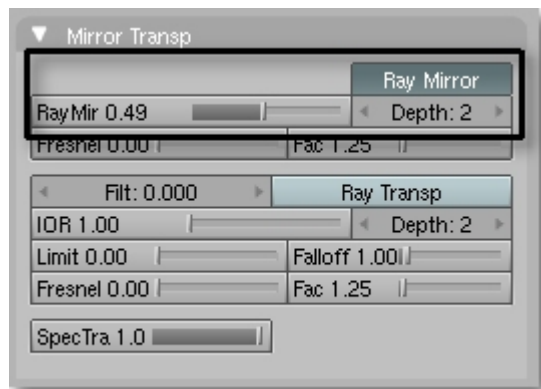
point the mouse cursor at the 2nd layer button, hold **SHIFT** and click **LMB**

We will be looking at the power supply and lead material a little later but for now let's enable ray mirror reflections in the desk material.

Set Raytrace reflections for the material

NOTE: You should by now be gaining confidence and knowledge of the fundamental Blender tasks such as selection. Beyond this point I will only explain exact mouse or keyboard strokes for obscure, or new, keyboard strokes. If you forget what the key is, or mouse strokes are, just skip back to earlier exercises to refresh your memory.

- Select the desktop object and move to the **material** button and the **Mirror transp** tab.



This tab may appear complex, dealing with things like **Fresnel**, **Falloff**, and **IOR**, but for our use, where we only need reflection, there are only 2 settings, and one button, that need concern us.

Ray Mir is the amount of raytraced reflections and varies between 0 and 1.

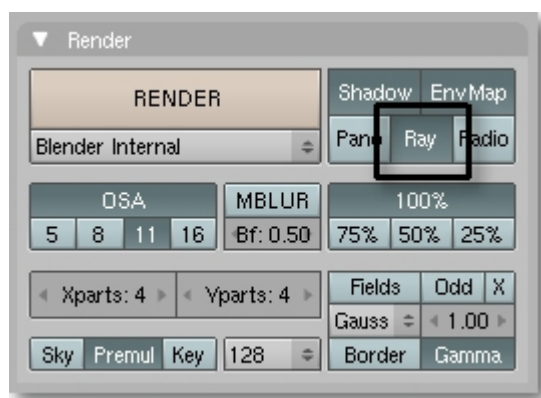
- set it to **0.49**

Depth is the depth of calculation Blender takes to trace the ray. The default is **2** but its range is from **0** (no raytrace reflections) to **10** (longer but more accurate raytracing renders).


- Make sure it is set to **2**.
- To enable the **Ray Mirror** material effect turn on the **Ray Mirror** button.

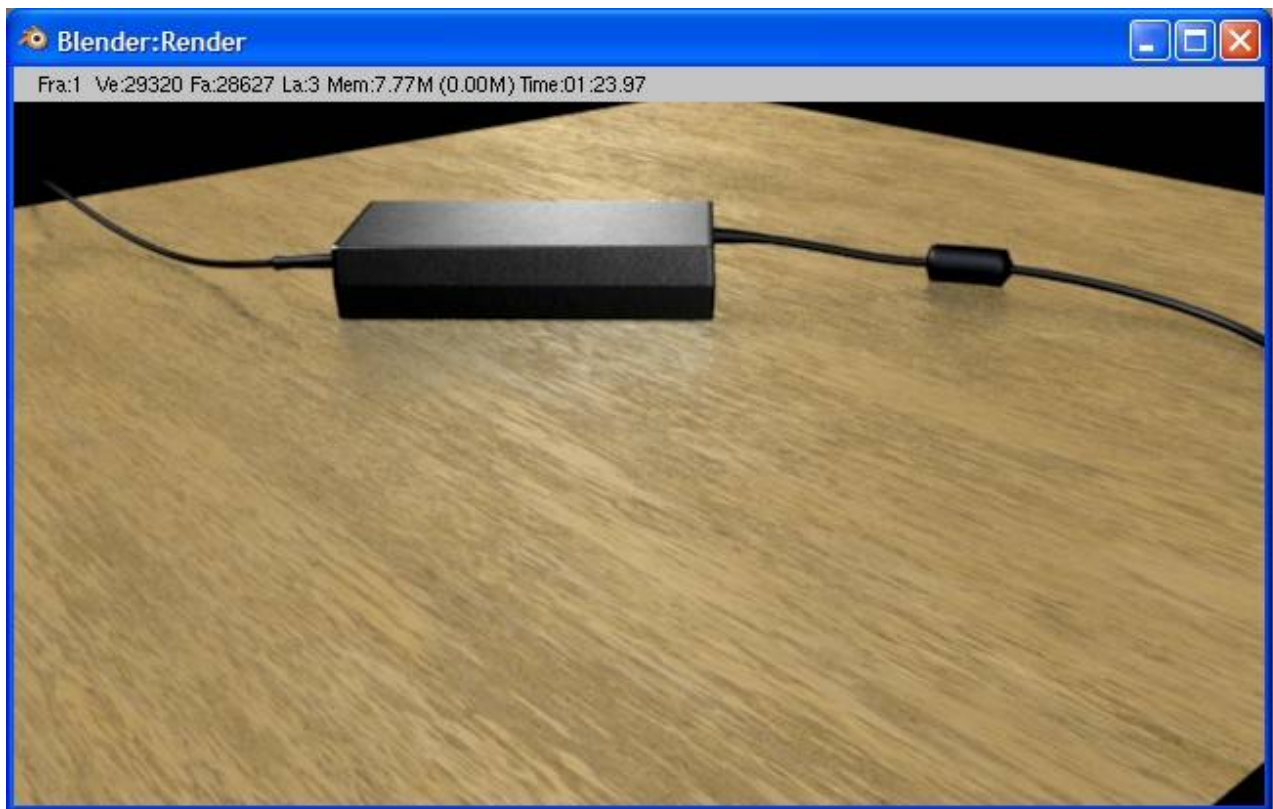
Confirm that the renderer is set for **Raytrace** in the **Render** button.

- **F10**



Render the scene so far

- Either **LMB**  click the render button in the Scene Button **F10** or press **F12**



The whole surface is looking much more realistic. However, real materials and surfaces will have subtle details on them that make the eye distinguish reality.

Adding a History to a Material (Getting Dirty)

Close examination of the real desk surface show polish and dust accumulation, as well as a few knocks and marks, here and there. If we can add these subtle hints to the materials history we can produce a much more pleasing material simulation.

A materials history can be broken down into 3 possible areas

Dirt

All real materials get dirty either by dust in the atmosphere or by interaction with liquids or sticky substances.

- dust will collect in crevices
- dirt will transfer from mucky hands or dirty objects onto a surface over time.

Damage

Given time any surface will sustain damage either by interaction with atmosphere or by being knocked or marked directly.

Other things applied to a surface such as posters or labels

In this modern age we can't leave a natural surface alone. Labels either stuck on, or embossed in, a surface are commonplace.

Even natural surfaces interact with growing things that will attach themselves to a surface and therefore alter its material properties.



Although the real desk surface is pretty clean there is nothing to stop us adding a little dirt & damage. I sometimes enjoy a cup of coffee at my desk. While I typically use a coaster to protect the desk surface lets pretend that I have in the past placed an overfilled coffee cup on the desk surface.

NOTE: On close examination of my desk I, and my cleaners, can categorically state that it is one of the cleanest desks in the land. HONEST.

The stain of a coffee cup is a unique shape and we therefore can't use a procedural texture to imitate it. However, such a stain is very easy to produce and get into Blender.



The image above was created by placing a coffee cup on paper, drying off and then scanning to an image. Finally I cleaned up the picture in a paint program to give more contrast.

NOTE: As I have said before it's always a good idea to pause occasionally when working on this addictive 3D material creation. A cup of tea, coffee, chocolate or other libation will force you to relax and exercise you legs.

Image textures

As with any decent 3D suite you need a way of applying photographs, or graphic images, created in a separate paint package, to a material simulation. Blender is no exception and has some wonderful tools that make the job easy.

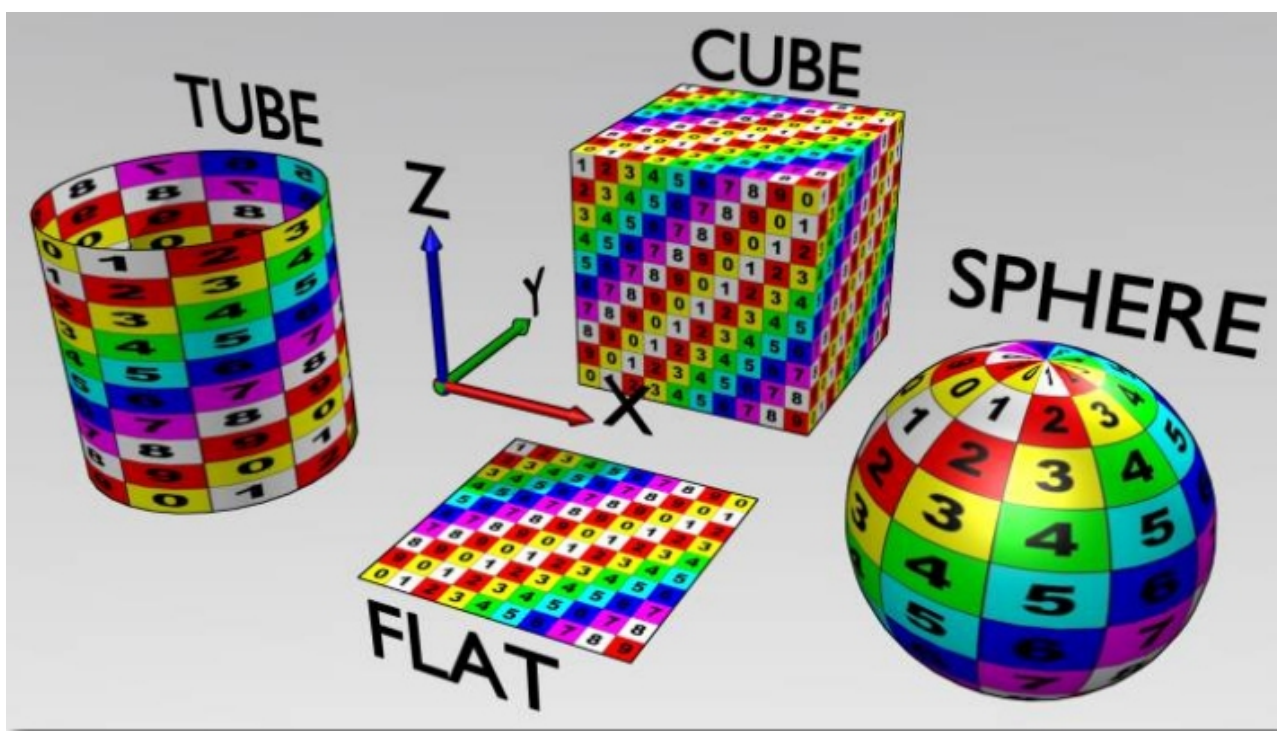
There are 2 strategies for applying an image to a texture.

- Standard image mapping - where a picture is projected onto a surface from a single direction, and
- UV mapping - where a mesh is unwrapped to a flat surface upon which the image is placed. This method allows every face of a mesh to receive the image.

UV mapping is the preferred method of mapping for professional work. It is however, very complex and tricky to use effectively. Distortion and differences in scale across the required image can be problematic. Therefore great experience is required to get it right. For that reason we will not be dealing with UV-Mapping in this beginner's tutorial which would probably require a complete section on its own. However, before you can even consider UV-mapping you have to know how to map a straight image texture to material. Learn this method and UV mapping will become easier to understand.

Mapping an image to a surface

Plain image mapping can use one of 4 methods to project an image onto a surface.

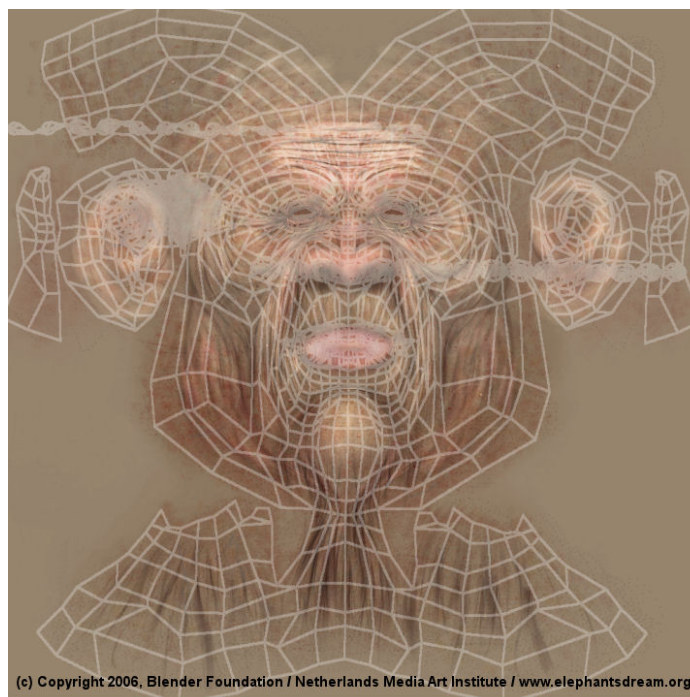


Blender Mapping types.

- **Flat** – which projects the image on the Z axis of the object? The easiest way to think of this is like a texture up or down onto a ground plane.
- **Cube** – Here the flat image is projected on each axis. Therefore a cube would receive the same image on each of its six sides.
- **Tube** – As its name suggest the image is projected around the Z axis of the object from a central point. In other words the projector pans around the tube.
- **Sphere** – Here the image is projected from a central point in all directions.

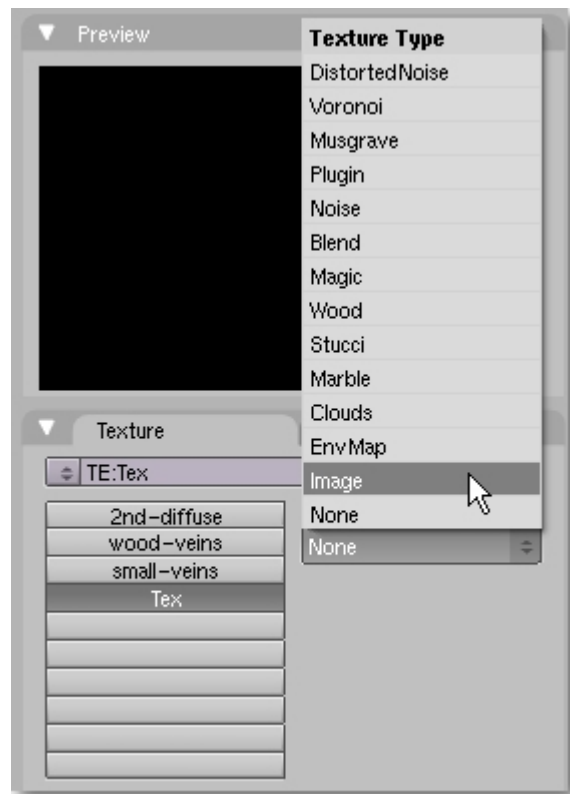
Obviously there will inevitably be some distortion if the object is not a perfect square plane, cube, tube or sphere. You might think that the best mapping for a human face might be the Sphere type. However, the human face has annoying bumps and hollows; nose, ears, chin, and eye sockets, that will distort the sphere type map.

That's why for such complex shapes it is best to use UV mapping.

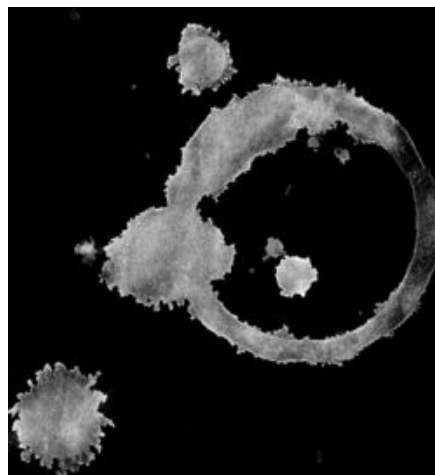


Fortunately we only need to map a simple image to a plane. We can therefore use **Flat** mapping with no distortion. However we also need to position and scale the coffee cup mark. In other words place it exactly where we want. Let's start by adding a new texture to our desktop material.

- With the desktop object selected press **F6** to change to the **Texture Button**.
- Select the next free available texture slot and select the **Add New** button.
- from the available **Texture Type** rollout select **Image**.



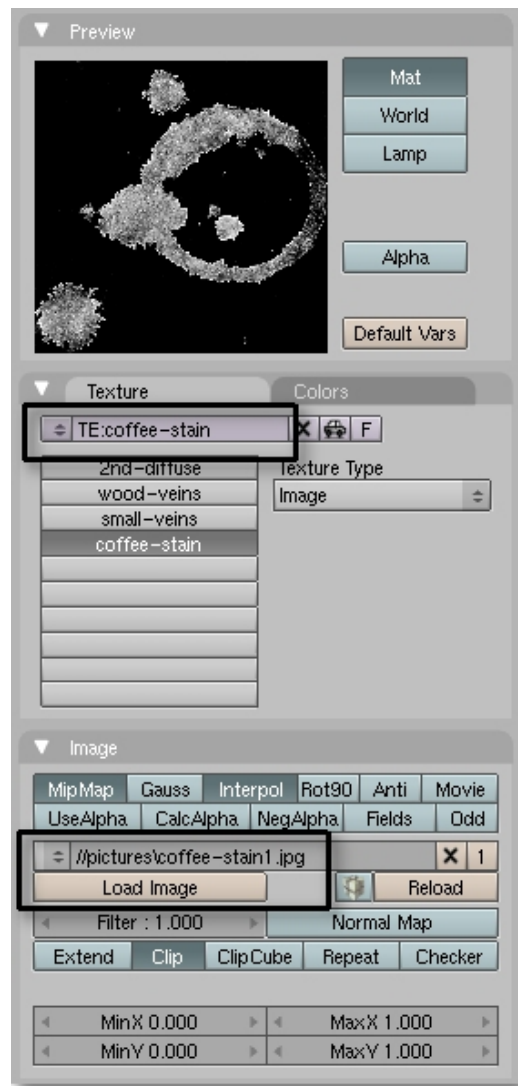
This is the image we will use for the coffee stain.



It was created, as explained earlier, by scanning a real coffee stain on paper and adjusting the contrast in a paint program. It was also converted to greyscale and negative . We will use Blender Materials to add color later.

Select the image above to get the fullsize version. Then Right click the image in your browser to download it to your blender directory.

NOTE: Although you can save and use image files anywhere on your system it's a good idea to put them into a directory structure that will make it easy to find them for future projects. In my case I have created a pictures folder below the folder that holds my blendfile.

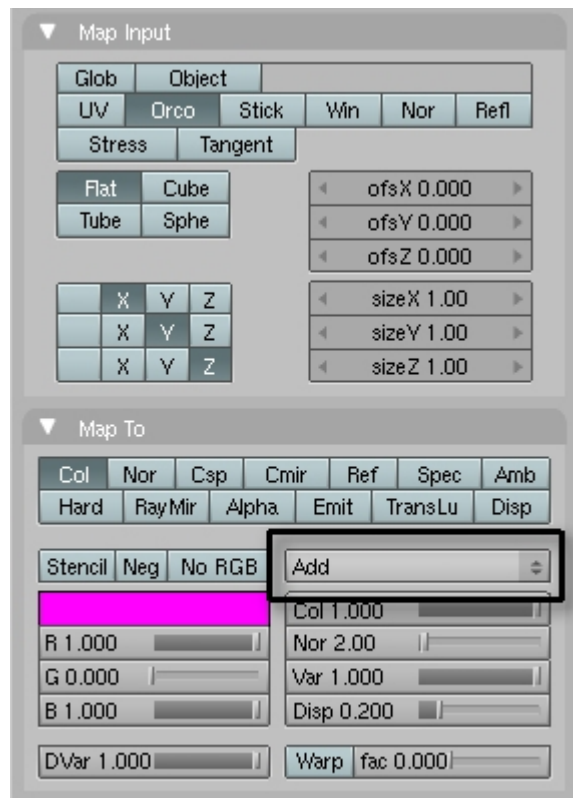


- From the **Image** tab select **Load Image** and locate the coffee-stain1.jpg file.

I will explain the settings in a moment but for now those shown are the defaults which is not a bad place to start.

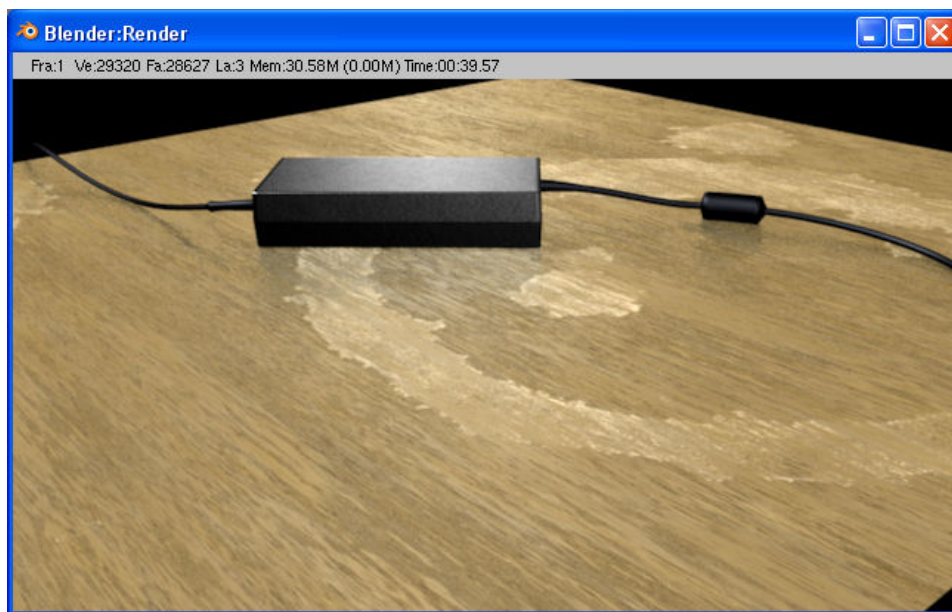
Return to the **Materials** button **E5** so that we can set how the image will be mapped to the desk surface.

Orienting and Scaling an Image Texture to a surface

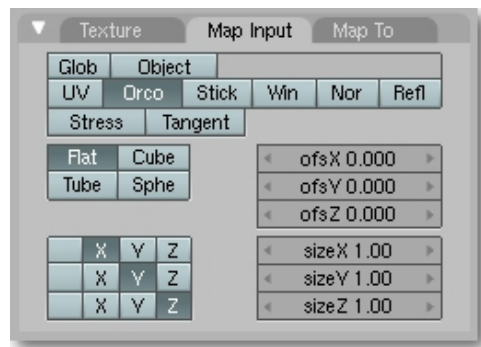


These are the defaults apart from setting the mixing mode to **Add**. In a moment I will explain the mixing modes in detail but for now the reason I have set it to Add is so that it will be clearly seen on the desk surface.

- Press **F12** to render the scene.



As you can see the coffee stain has lightened the desk surface. But it is far too big, unless I have a serious coffee addiction.



The image has been mapped to fill the whole of the mesh plane. For our purposes we need to change the size, or scale, of the image and position it on the desktop in an appropriate place.

We can change the scale and position of an image texture by altering the **sizeX,Y,Z** and **ofsX,Y,Z** in the **Map Input** tab of the **Material** button.

There are several ways in which you can position and scale an image texture to a surface. You will learn other methods later but the one I show here will help explain further the Map Input switches and their uses.

Map Input

Currently the image is mapped to the whole of the mesh co-ordinates. This means that an object has its own material co-ordinates, usually aligned and scaled to the object but it is possible to change that.

This type of mapping is called **Orco(ORiginal COordinates)** in Blender and is the default. As you can see from the **Map Input** settings there are quite a few others available. These are explained in the Blender documentation.

http://mediawiki.blender.org/index.php/Manual/PartIV/Map_Input.

However, here are some other useful attributes of these map input types.

- **Glob(al)**
 - As its name suggests the material will be scaled and oriented to the global co-ordinates. This would mean that if the object moved in an animation the material will stay still.
- **Object**
 - With this type you can attach the material co-ordinates to another object such as an Empty. The other object must be named and of course exist. This is incredibly useful as you can animate that other object to move, scale, and rotate, the material.
- **Orco**
 - The default mapping method to the object material co-ordinates. If the object moves the material will move with it. In most circumstances this default works just fine. It is possible to translate the Orco co-ordinates in scale and position.
- **Win(dow)**
 - The texture is mapped as though being projected from the camera. Therefore if the camera moves so does the texture.

- **Stress**

- This is a brand new **Map Input** type and basically allows a texture to alter based on stress of the mesh. That means if the mesh is stretched from its default state a material or texture attribute can be made to change also. Here is a link from Blender v2.42 release log. Potentially this could have some interesting uses beyond the rubber example shown.

http://www.blender.org/cms/Material_Features.764.0.html

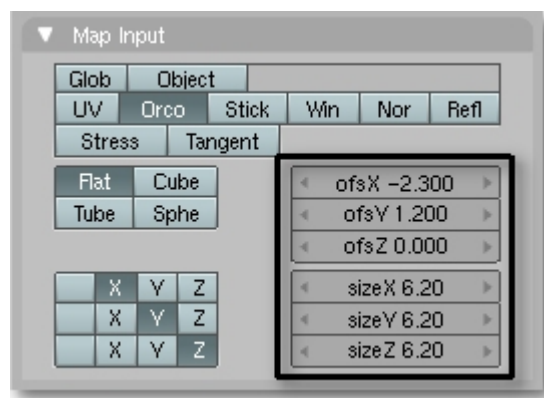
- **Tangent**

- Another new and interesting map input type for creating the look of brushed metals. However, the current Blender release, 2.42 only allows this type with UV mapping. Therefore it's beyond the scope of this training material.

There are other exotic mapping methods which, although useful, are not usually necessary with the majority of texture needs. However, if you would like to explore them read the Blender Wiki pages:- http://mediawiki.blender.org/index.php/Manual/PartIV/Map_Input

Back to the coffee stain texture

These are the settings that I found were best for the coffee stain.



Size

Set **sizeX**, **sizeY**, and **sizeZ** to **6.20**

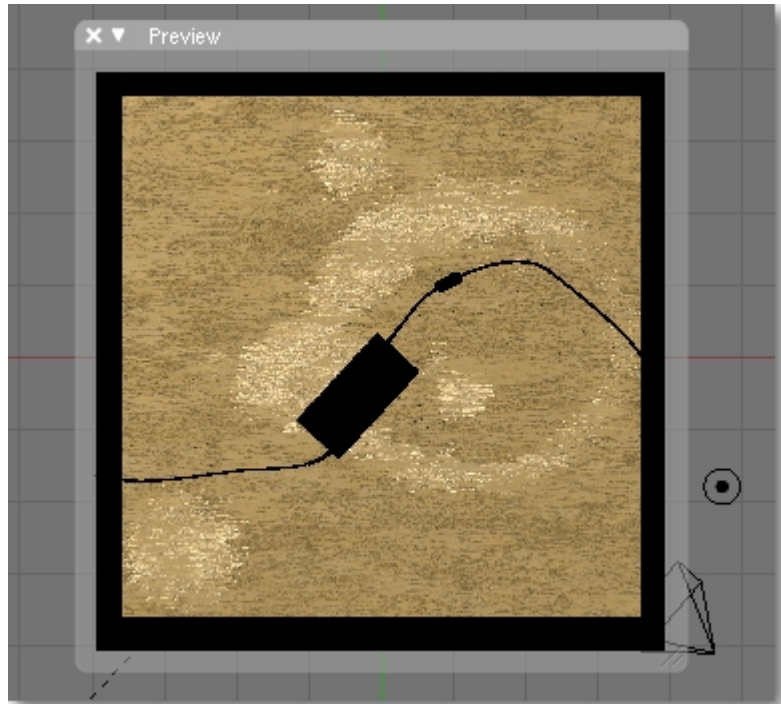
Position (offset)

Set **ofsX** to **-2.300**

ofsY to **1.200**

ofsZ to **0.000**

Previewing to Help



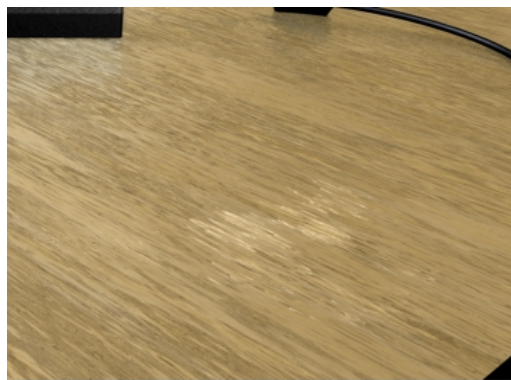
A really neat trick, to help you with this repositioning, is to set a preview **SHIFT+P** in the top viewport.

Any of the editing windows can be set to the top viewport by pressing **NumPad 7**. As you update the scale and offset values in the **Map Input** tab you will see the preview update.

Other View Controls

- NumPad 1** - Front View
- NumPad 2** - Rotate View Down
- NumPad 3** - Side View
- NumPad 4** - Rotate View Left
- NumPad 5** - Ortho/Persp
- NumPad 6** - Rotate View Right
- NumPad 7** - Top View
- NumPad 8** - Rotate View Up

If you were to render the scene now you would see a rather disappointing coffee stain that only appears in the wood grain. Why is that?



When we started creating the textures for our desktop we set some **Warp** and **Stencil** effects on previous texture layers. These will affect all textures that follow them.

The **Warp** effect can be turned off on a subsequent texture layer but **Stencil** cannot. That means to get an undistorted coffee stain it really should have been the first texture.

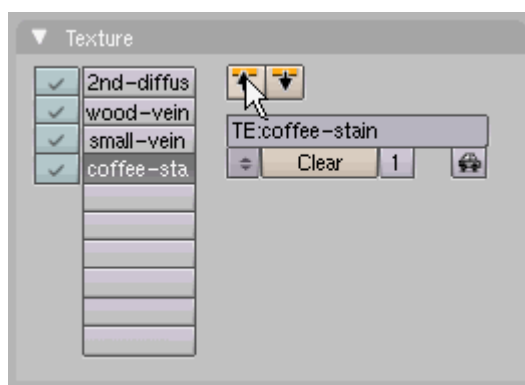
Re-ordering textures

Fortunately Blender has tools to help with this process.

Buffer

You may have wondered what those up and down arrows were in the **Texture** tab of **Materials** **button**. These give you access to a temporary storage area called the buffer.

You are able to copy a selected texture to this buffer then paste it into another texture slot.

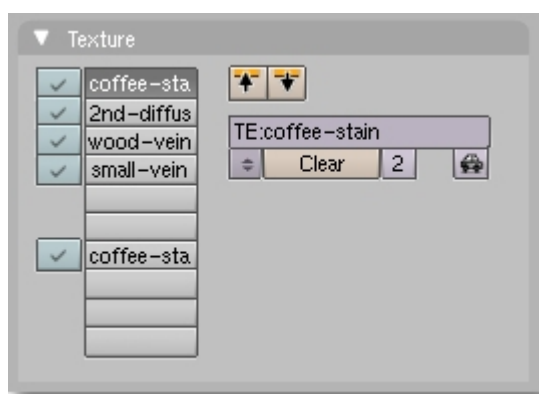


All material settings, like **Map Input** and **Map To**, are copied with the texture. It is therefore a very useful tool.

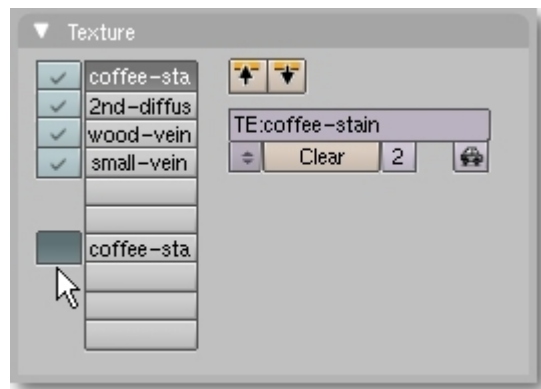
Exercise

Your turn to try this out on your own. I want you to copy the other textures down by one slot, then copy the coffee-stain texture up to the 1st texture slot.

You should end up with this.

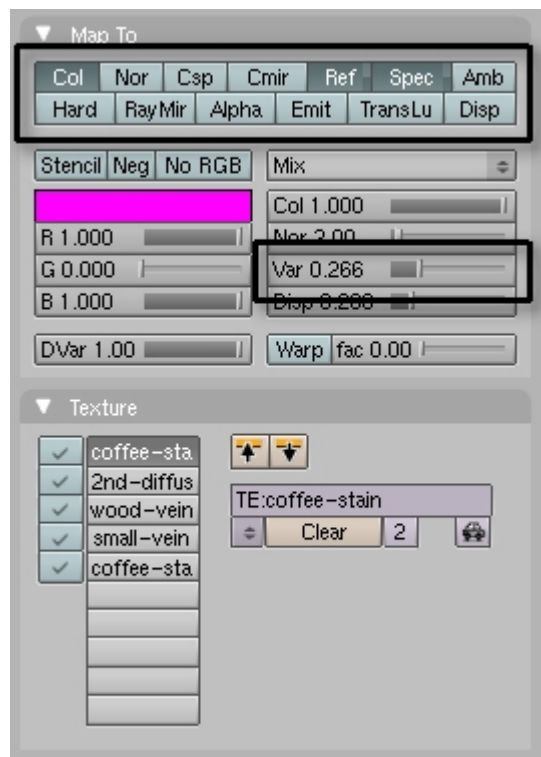


You will notice that the coffee-stain texture shows that there are 2 copies in this material. Don't worry about that for the moment because we can use the other copy for a nice special effect. However, **LMB** the arrow by the second coffee-stain texture to temporarily turn it off while we set the Map To settings for the first.



Setting the Map to Options for the 1st Coffee Stain Texture

With the first texture slot selected in the **Materials Button** select the **Map To** tab so that we can set the way this texture will be combined with the material color.

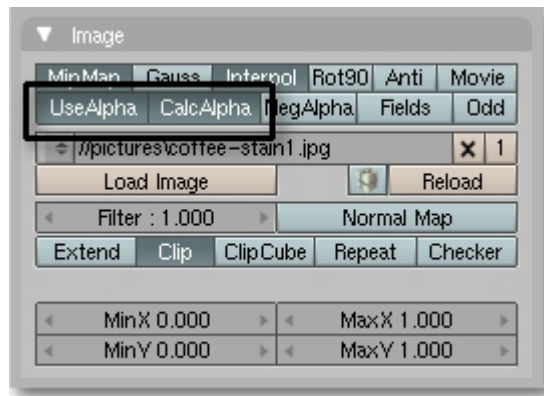


If you were to render now the effect wouldn't be quite right. Here I have just rendered a portion of the screen centred on the coffee stain.



The **Mix** blend mode has mixed both the Black background, of the image, as well as the stain mark itself. We need to get rid of the black background. Once again Blender has the ability to do this.

Switch to the **Texture Button** F6 and in the **Image** tab select **CalcAlpha** and **UseAlpha**. This will make the black area of the image transparent.



NOTE: : Alpha, in materials, is quite complex. Here we are not using any alpha to make the material itself transparent. However, there are examples in later files that use material alpha.

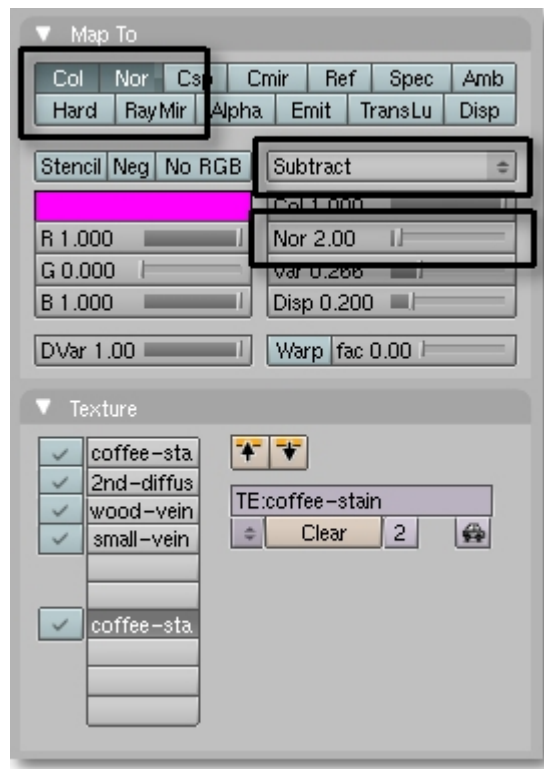
- Switch back to the **Material** Button. I am sure you don't need to be reminded of how to do that. (**HINT: - F5 no more hints.**)
- **F12** to re-render.



Quite a subtle effect but the stain has slightly bleached the surface and because the coffee contained far too much sugar the specular and reflective difference between the normal table and the stain can be seen.

Adding some magic

We can now use the second copy of the coffee stain texture. The texture is shared between the two slots, but each can have its own unique **Map To** settings.



- Set **Col** and **Nor** on to give us both color and a bump map effect. Change the blend mode to **Subtract** to give a darker color to the stain. and set the **Nor** value **2.00** to increase the bump size.

If you render now this is what you would see.



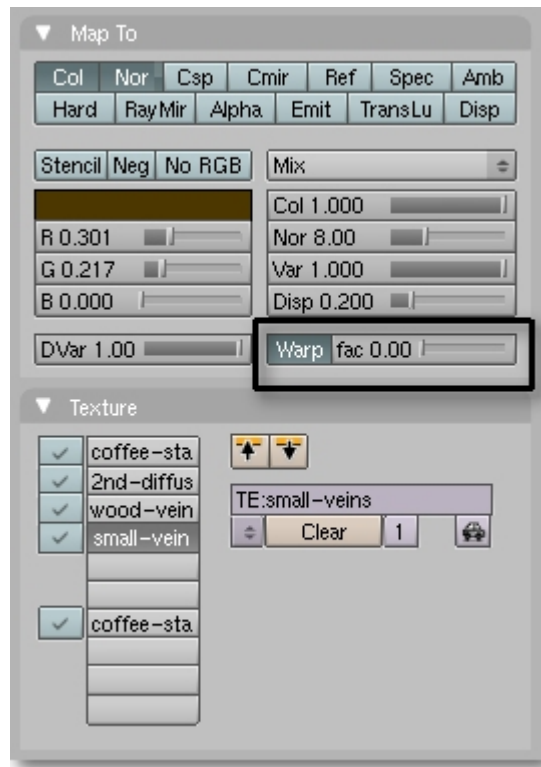
Some of the wood grain has become darker as though coffee has spilled and dried in the crevices. However, it's a bit random at the moment. Why might that be?

Order of textures and their effect on each other

Previously we set both a **Stencil** texture, that will mask some areas of all future texture layers, and a **Warp**.

Once a **Stencil** is set you can't turn it off but the **Warp** can be.

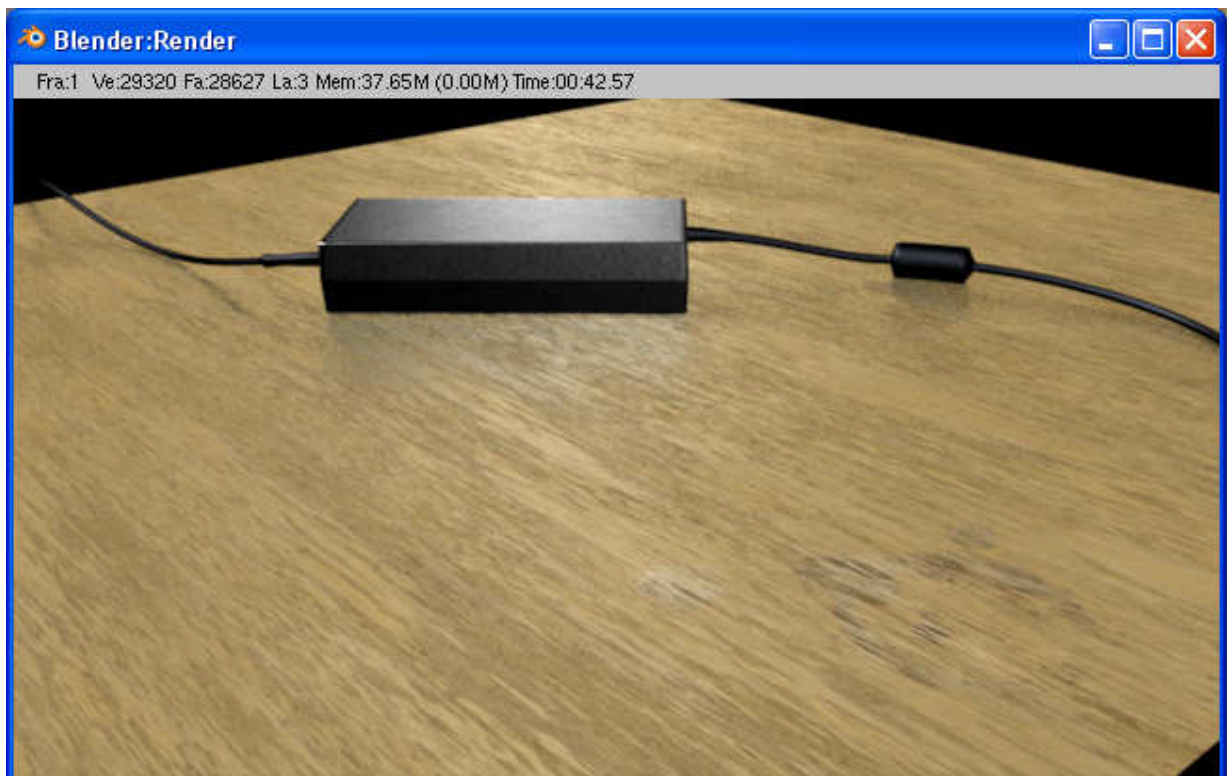
- Select the texture slot immediately before the last coffee stain texture.



- Set **Warp** on but make sure the **fac**(tor) amount is set to **0.00**.

That means from this texture on any preceding warps will have no effect.

One more render



We are almost there. The desktop is a reasonable simulation of what I can see in front of me with a few artistic interpretations and additions such as the coffee stain on its surface.

The power supply and leads also offer other incites into Materials and Textures that are worth exploring. Rather than starting from scratch the materials have already been created for you. However, since this is a hands-on training programme I want you to discover a few extra fundamental principles by spending a few minutes looking at some of the settings. I also end this section with a simple exercise that will prove your understanding of image manipulation.

The Power Supply

The power supply and leads are an interesting material challenge. In both cases their diffuse color is Black which as you all know is the absence of color. Therefore how do you make a black material look 3D and not just a silhouette?

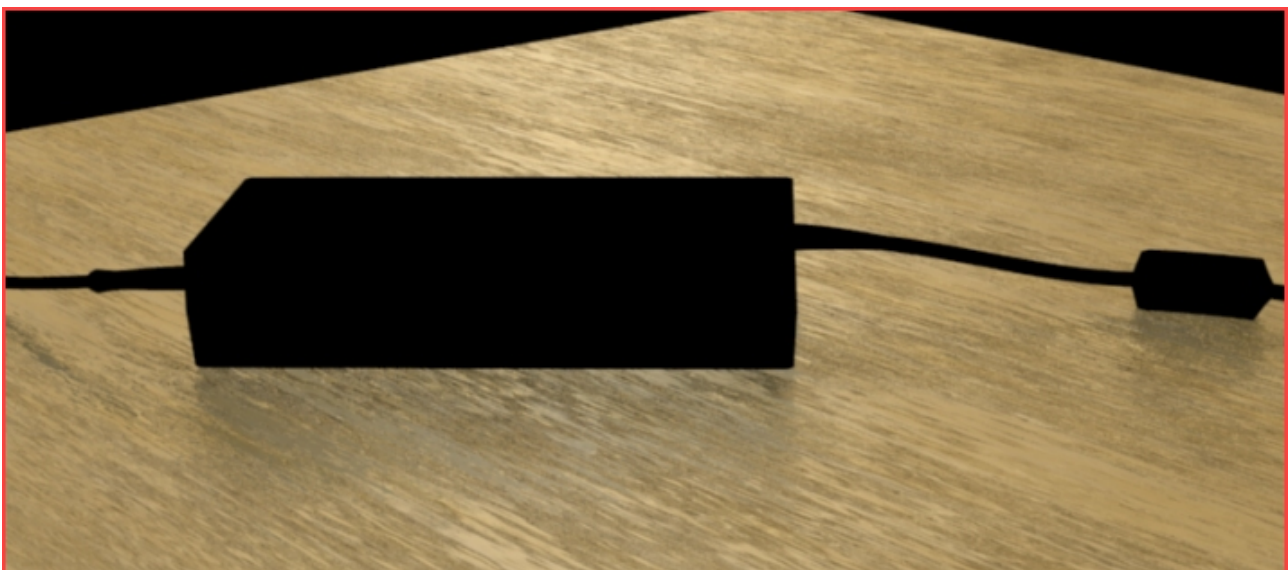
Specular highlights

If the diffuse color is black it's only the specularity of the surface that can potentially show the object shape. You can see this if you set the power supply material to Shadeless and then render.

- Select the power supply mesh **RMB**
- Switch to the Material button. **F5**
- from the **Material** tab select **Shadeless**



- F12 to Render.

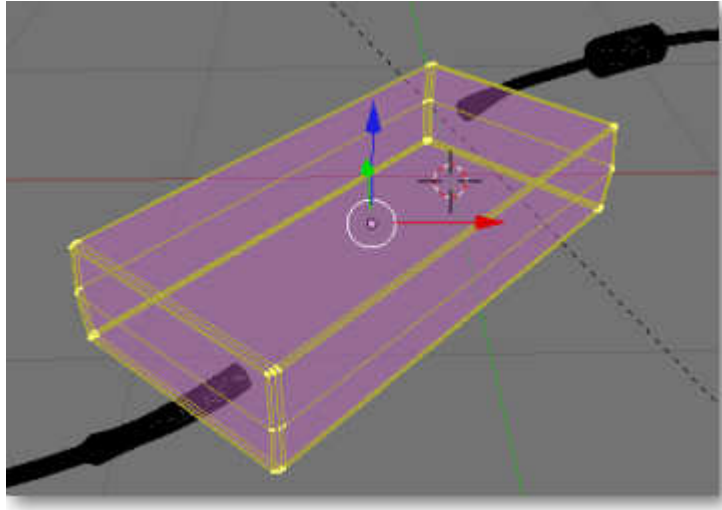


As you can see the power supply is just a silhouette. So specular highlights are important, with any material, to help describe the shape.

- Turn off shadeless for this material.

Make the mesh work for the material

The meshes for both the power supply and leads are very simple. The power supply is a subdivided cube object that has been scaled and edge bevelled to give some nice corners to reflect specular highlights.



In reality no object has totally sharp edges. Therefore these should be avoided in any object we create. Blender has some tools to help create bevelled edges which you can read about here.

http://mediawiki.blender.org/index.php/Manual/PartII/Edge_and_Face_Tools#Bevel

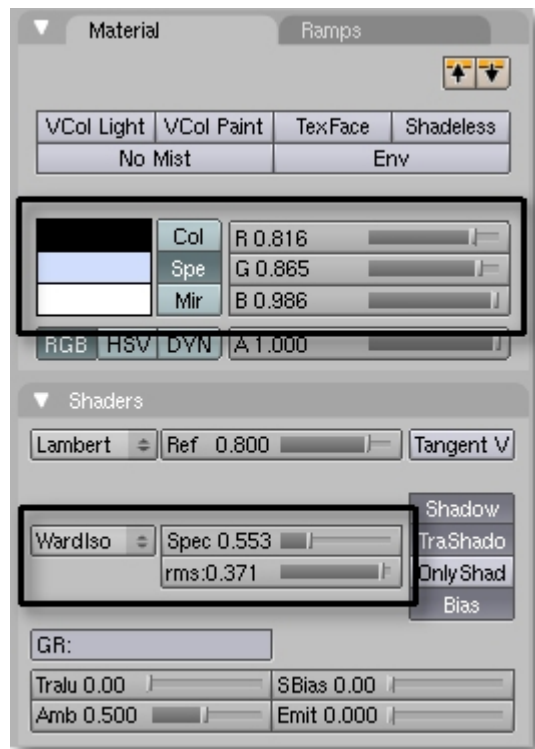
Fortunately the power supply, that I have attempted to model, has bevelled edges as part of its design.

Here is a render of the materials with just the specularity set and no bump maps.



Specular Color

- select one of the two leads and from the Material button and examine the **Material** and **Shaders** tab.



As you can see the **Spec** color of the Material has been changed from the default white to a subtle blue. It almost gives the material a rubberised look. The reason for setting this was following close examination of the real material and noticing the small change in color of the specular highlights.

The same could be said for the **mirror** color but since this material doesn't use ray mirror there is no point in changing this.

Small differences in Color Settings

There is always a temptation to make large changes to these colors simply because one can. The color sliders vary from 0 (off) to 1 (full). More often than not minor differences, from the default which is pure white, are all that is required.

The label on the power supply

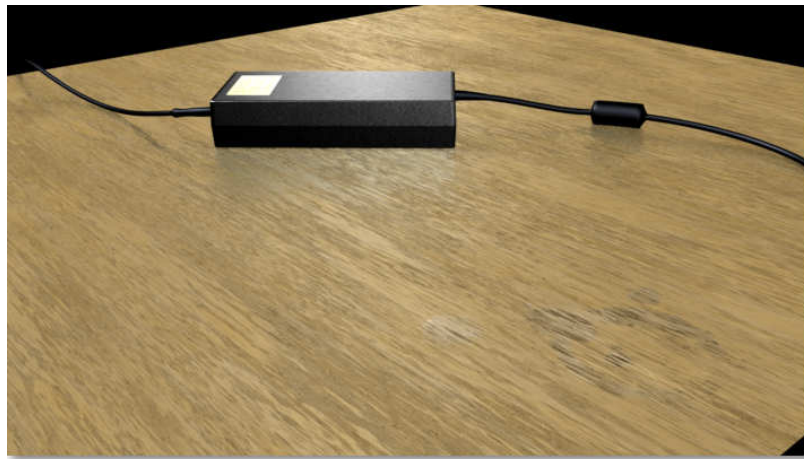
Before we leave this desktop exercise, to move onto more dramatic material creation, I wanted to talk to you about the label on the power supply.

If you look at the **material** button for this mesh you will see that there are 2 extra image textures. These were created by photographing the real label and upping the contrast slightly in a photo program. I also copied the file and split the colors into Red, Green, and Blue. I then used levels within my paint package to adjust the best one to give a simple white copy of the label to act as a mask and specular map. This was so the granulated surface of the case did not appear on the label. I also want the label to have a shiny surface compared to the black power supply.

Examine the material and work out how I achieved that.

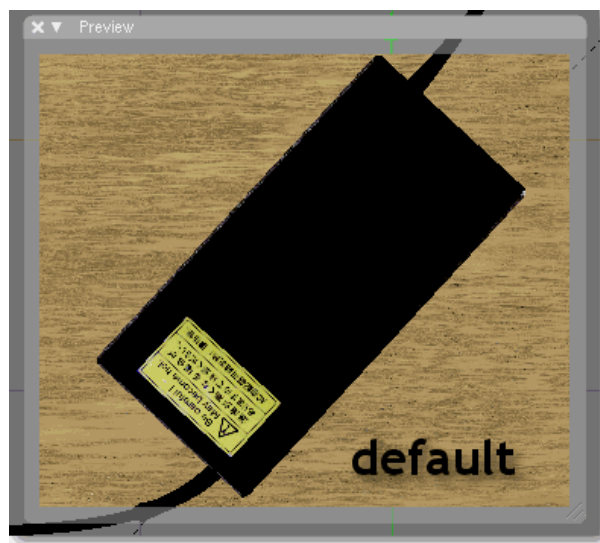


Finished Render result



Exercise

OK we have covered a lot of ground with this opening tutorial. Shortly we will move on to a more complex but spectacular scene as well as learning in greater detail some of the features of Materials and Textures in Blender.



Easy Exercise:-

To test your understanding of image mapping I want you to try and move the label from where it appears in my renders, which I will call default to the opposite right side.

Difficult Exercise:-

Rotate and re-scale the label so that it appears in the middle of the power supply. You must be able to read the first sentence of the label.

As a tip look into the **Texture** tab of the **Texture** button and look for the **Rot9(0)** button. You will still have to do some interesting things with the size buttons in the **Map Input** tab to avoid the image being mirrored. (**EVEN BIGGER TIP:** It involves negative numbers)

Use the Preview **SHIFT+P** in a top view window to help you orient.